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Recent literature reflecting the impact of technological change on the occupational distribution of the labor force and on work patterns and skills is reviewed. Social and policy implications of technological change which are considered include mechanisms for improving the coordination between labor supply and demand and the problems and prospects of a future leisure society. The effect of technological advancement on the occupational distribution of the labor force is discussed in reference to professional, technical, skilled, unskilled, blue collar and white collar workers. Also 13 abstracts of materials published since 1966 are included. The effects of technological change on work patterns and skills deals primarily with the nature of the worker response to technological change and the question of whether skills levels are raised or lowered as a consequence of automation. Abstracts of 17 books and articles published since 1965 are included. The effects of technology on the problems of social choice in the allocation of resources amon g productivity, leisure and retaining goals is discussed, accompanied by 16 abstracts of materials published in 1965 or later. The document contains an alphabetically arranged author index to the abstracts. (CH)

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The Harvard University Program on Technology and Society was established in 1964 by a grant from the International Business Machines Corporation to undertake an inquiry in depth into the effects of technological change on the economy, on public policies, and on the character of the society, as well as into the reciprocal effects of social change on the nature, dimension, and directions of scientific and technological developments.

Comments, criticisms, and suggestions concerning this document and the general format of the series will be appreciated. Please address correspondence to Irene Taviss, Harvard University Program on Technology and Society, 61 Kirkland Street, Cambridge, Mass. 02138.

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This issue was prepared by Irene Taviss and William Gerber of the Program's Information Center.

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NOTE

These research reviews are issued quarterly by the Program's Information Center. They are designed to provide an appreciation of the literature in particular areas under study within the Program. No attempt is made to offer a general bibliographic service covering the entire technology and society field. Lengthy abstracts of a small number of carefully selected books and articles are presented, preceded by a brief state-of-the-art essay and by summary statements covering each subcategory of titles. The materials selected for abstracting are those which have had some impact on the field, which present a significant analysis of issues or a useful compilation of data, or which are representative of different outlooks and viewpoints. An effort will be made to issue a review in the same area at intervals of approximately two years in order to provide follow-up coverage.

The present review deals with the impact of technological change on the occupational distribution of the labor force and on work patterns and skills. Some social and policy implications of these changes are also considered, especially: mechanisms for improving the co-ordination between labor supply and demand and problems and prospects of a future "leisure society." Literature on the effects of technology on the aggregate level of employment and detailed case studies of specific industries have generally been excluded.

It should be noted, finally, that most of the items covered in this review were published since 1966.

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INTRODUCTION

The pace of technological change in industry has been a source of much public concern. In the late 1950's and early 1960's the literature on the subject was often characterized by the extremes of grave pessimism concerning the masses of people who would be "thrown out of work by machines" and utopian optimism about the "leisure society" in which man would at last be freed from "the burdens of labor." By the mid- and late 1960's more sober views began to prevail. In 1966 the National Commission on Technology, Automation, and Economic Progress issued a comprehensive report on the subject. It concluded that although technological change plays a major role in determining the particular persons who will be displaced, the rate of economic growth rather than technological change *per se* is the principal determinant of the general level of employment. To keep the level of unemployment to a minimum, therefore, "aggressive fiscal and monetary policies to stimulate growth" are needed.[1]

The significance of economic policy in determining the employment effects of technological change serves to illustrate the general importance of social structures and attitudes in mediating between technology and its effects. The impact of technology on occupational structure and on patterns of work behavior is rarely a direct one. The frequently noted discrepancies in the literature concerning whether automation raises or lowers skill requirements, whether it increases or decreases job satisfaction result from this fact. The same technology may have different effects depending upon the reaction of the specific organization or social structure into which it is introduced. It has been noted, for example, that the reduction in middle-level white collar positions often results not from automation directly but "from the re-organization of the office resulting from automation, such as the centralization of the office work."[2] Yet such centralization is itself not a necessary consequence of office automation. For organizational structure – the division of labor, levels of hierarchy, and channels of communication – intervenes between automation and its effects. Thus, it is only in traditional "line" organizations which do not allow for horizontal channels of communication that disputes between the computer experts and the line managers will tend to be resolved by the head of the organization, thereby leading to a high degree of centralization of control. When "an organization can dispense with the concept of a rigid chain of command and allow horizontal interchange, then automation will have little impact on its members' ability to co-operate with one another," and such centralizing tendencies will not emerge.[3]

Such large-scale changes in the occupational structure as the growth of the service sector and the increased importance of education are again the result of an interaction between social and technological factors. Although there is some dispute about the magnitude of these changes, it is generally acknowledged that technological advance in the production and processing of goods has allowed the growing demand for goods to be fulfilled quite adequately by an increasingly smaller proportion of the total work force. At the same time, the introduction of advanced technology into the service sector has not resulted in a reduction of labor needs, so that there has been some

growth in service sector employment as the demand for labor elsewhere has decreased. But technology is only indirectly responsible for the growth in demands for services. This demand has grown as the society has become more affluent. Generally, as income has risen, the demand for services has increased more rapidly than the demand for goods. Moreover, growing affluence has supplied the basis for expanded efforts to provide a greater proportion of the population with such services as health and education.

The enhanced importance of education as a prerequisite to employment is likewise a product of both social and technical factors. For in a society with sufficient wealth to allow large numbers of people to postpone entry into the labor force so that they may receive more education, employers often have a sizeable pool of educated manpower at their disposal. Given the value placed upon education in our society and the ease with which educational credentials may serve as a screening device, employers will often prefer to hire the more educated, even though the intrinsic requirements of the job do not call for such education. It is certainly true that as technological advances have diminished the need for unskilled manual labor, the newer jobs tend to require more education and training. Education also tends to produce a greater flexibility in the worker, although there has been some recognition that "overqualified" manpower may create problems. There are many indications, however, that the educational requirements for a given job are often exaggerated. The most frequently cited and well-known example is that of computer programming. Initially, only college graduates – and usually those with training in mathematics – were hired as programmers. Today, high school graduates – and in some instances even high school dropouts – are being trained for the job. James Bright has been so impressed with the interaction between social and technical factors in the work sphere that he argues that while automation affects the skill level required for certain jobs, the available pool of manpower skills in turn influences the progress of automation. In his "law of automation evolution," he asserts that machinery evolves to provide the degree of automatic operations which is "economically supportable by the level of skill that can be made readily available in the existing work force." Thus, "when the machine manning needs have been reduced to a standard that is normally available in the local work force, ... the economic incentive for automation progress disappears."[4]

As industrial society has moved through the stages of technological development from mechanization to mass production to automation, new tensions and accommodations between the technology and the social structure have appeared at each stage. While we are still in the transition towards an automated society, with only a small percentage of the labor force employed in automated industries,[5] some of the trends of the emerging "postindustrial society" have come to be visible. Thus it appears that the major issues confronting our society as a result of technological developments and occupational change will center about the nature of the "knowledge society" and the new social choices and decisions that it requires, and the changing patterns of work and leisure.

THE KNOWLEDGE SOCIETY

The basic change which technology has effected in the occupational structure is most often symbolized in the distinction between the pyramid-shaped structure of the early industrial labor force and the diamond-shaped structure of the modern industrial system. As the repetitive manual labor which constituted the base of the pyramid has been replaced by machine power, the base has

shrunk and there has been a widening near and below the top which reflects the need for white collar workers and technicians, salesmen and managers, administrative and co-ordinating personnel, and the scientists, engineers, and other professionals who generate and implement the knowledge and technology so important to a modern society.

As Daniel Bell has observed, our society may be characterized as a "knowledge society" in two senses: "first, the sources of innovation are increasingly derivative from research and development (and more directly, there is a new relation between science and technology because of the centrality of *theoretical* knowledge); and second, the 'weight' of the society – measured by a larger proportion of Gross National Product and a larger share of employment – is increasingly in the knowledge field."[6] The number of professional and technical workers in the United States labor force more than doubled between 1947 and 1964. "By 1975, manpower requirements for this occupational group are expected to rise by more than half, to 13.2 million persons. If one assumes a total labor force at that time of 88.7 million, then the professional and technical group would make up 14.9 per cent of the working population. If one adds in, as well, an estimated 9.2 million managers, officials, and proprietors, then the total group would make up 25.3 per cent of the working population. In effect, one out of every four persons would have had about four years of college – the educational average for the group – and this 25.3 per cent would comprise the educated class of the country."[7] Within this educated class, "the most crucial group, of course, in the knowledge society is scientists, and here the growth rate has been the most marked of all professional groups...whereas between 1930 and 1965 the work force increased by about 50 per cent, the number of engineers increased by 370 per cent and that of scientists, by 930 per cent."[8]

What do these developments mean for the future of the occupational and class structure of our society? Many writers of science fiction or utopian novels have protrayed a two-class future society composed of the educated and the uneducated. John Kenneth Galbraith has expressed a similar notion: "When capital was the key to economic success, social conflict was between the rich and poor.... In recent times education has become the difference that divides."[9]

The increased importance of educational attainments for entry into higher level positions does not, however, ipso facto produce a rigid two-class society. The technological changes which have altered the occupational distribution and increased the need for more educated manpower provide, in the long run, expanded opportunities for upward mobility as the bottom level of the occupational hierarchy contracts and the upper levels expand. And indeed, a recent large-scale study of occupational mobility in the United States finds no evidence of increasing rigidity in the occupational structure.[10] But if the occupational structure is to continue to be an open and fluid one, a major social effort will have to be made to insure that all individuals in the society are educated to the limits of their ability and that the most effective use is made of the talents of the existing labor force.

The goal of maintaining a fluid occupational structure coincides with the economic and technological requirements of an advanced industrial society. The failure to make the most effective use of existing talents often results in a lack of co-ordination between labor supply and demand which is responsible for unemployment and economic loss. The inadequacies of current education and training systems likewise help to produce unemployment by failing to keep pace with the changing demands for labor. For "while few employees actually lose their jobs when radical technological improvements are introduced, it is likely that jobs which otherwise would have been available for

young people when they were ready to begin work will not be there. The suspiciously high unemployment rate for young people – about three times that for older age groups – suggests the validity of this hypothesis."[11]

The provision of adequate education and the proper identification of talent are essential not only for the reduction of unemployment and economic loss, but also for the very maintenance and growth of a system dependent upon advanced technology. In the past and in many of the less developed countries economic development has required large amounts of capital. "Tomorrow, however, the long-range economic expansions of the society will be limited by shortages in technical and scientific manpower. Such problems are novel. We know, from economic theory, how to raise money capital...but the source of brainpower is limited in part by the genetic distributions of talent and also by cultural disadvantages. The process of identifying and husbanding talent is long and difficult, and it involves the provision of adequate motivation, proper counselling and guidance, a coherent curriculum, and the like. The 'time-cycle' in such planning, a period of from fifteen to twenty years, is vastly different from that required in the raising of money capital."[12]

The requirements of modern technology and the values of an egalitarian social system thus converge to produce a need for revisions in our educational system and the establishment of some system of manpower planning. In the short run, it is incumbent upon the government to assure that jobs or income will be available to those workers who are displaced from their present employment. To this end, the Automation Commission has recommended: "(1) fiscal policy calculated to provide at all times a brisk demand for labor; (2) direct employment of any long-term residue of unemployed workers; and (3) income maintenance for families with inadequate earnings."[13] But in the longer run, new public policies must be devised to overcome present rigidities in the labor market (arbitrary retirement and hiring practices, racial discrimination, relocation problems), to provide a flexible system of education and training (on-the-job training systems, sabbatical leaves for educational purposes, new mechanisms for occupational guidance), and to secure a better match between labor supply and demand.

The re-allocation of resources that would be required for such institutional changes to occur poses many dilemmas of social choice. It has been estimated, for example, that in 1980, "given a $4,413 per capita GNP..., achieved with a 37½-hour workweek, a 48-week workyear, and providing retraining for 1 per cent of the labor force, society could choose to retrain much more heavily (4.25 per cent of the labor force per year) or, alternatively, could add 1½ weeks per year in vacation. In 1985, when per capita GNP should reach about $5,000, the choice could be between retraining almost 7 per cent of the labor force annually or taking an additional 3 weeks of vacation. Obviously, other choices could be made, involving a further reduction in the workweek, a lowering of retirement age, or an increased educational span for those entering the labor force."[14] The value issues involved in such choices include the following: "If the rate of technological change begins to exceed our ability to adjust to it, to what extent should the introduction of new production techniques be controlled? What price in individual freedom of action would we be willing to pay in order to eliminate unemployment among teen-age Negroes in urban ghettos? Although it seems obvious that we are becoming an increasingly leisure-oriented society, it is not nearly so apparent that we *should* become so. The increased national product resulting from a continuation of the present pattern of working hours plus increased productivity could be used to improve a wide variety of services, such as public education, that are not now adequately financed."[15]

Whatever the nature of the social choices that will be made to help minimize the disruptive effects of technological change and to maintain mobility and fluidity in the occupational structure, technological change in industry has resulted in the blocking of certain older paths of mobility. In industry, because of "the need for managerial personnel to have a broad educational and technological background,... a moat [has been established] between the workers and their foremen and all other supervisory personnel. It is increasingly rare for a working man to advance more than one step up the managerial ladder. He can become a foreman, but that is all."[16] Mobility in office work appears to be similarly blocked as "the middle step in the old promotion ladder" – positions requiring experience and seniority, but beneath the managerial level – appears to be growing smaller with the introduction of automation.[17] And among managerial and supervisory personnel in industry, "a 'gap' is forming between lower and higher levels of management.... Yet in the wide number of areas where promotional paths are being modified the extent to which modified job and work environments call for the (technical) degree is not clearly established. There is a clear tendency to overestimate its relevance. In addition, where higher level skills are indicated, the development potential of existing company personnel is frequently overlooked."[18]

Such inability to move up within the hierarchy of an employing organization has been a source of frustration to many workers; and since the blockage often results from exaggerated notions of the importance of formal education, there is an underutilization of existing talents. In many instances on-the-job training has been used quite effectively to permit the existing work force to assume the new roles and responsibilities. Furthermore, in the face of rapid technological change, even recent college graduates suffer from the problem of knowledge obsolescence.

For these reasons, some analysts have been advocating the establishment of "new careers" which would allow a worker to move from a nonskilled entry position to intermediate sub-professional functions and then on to full professional status through a sequence of on-the-job training and formal education, with new types of accreditation that would reward experience gained on the job. Currently, Arthur Pearl and Frank Riessman argue, "society insists that training take place prior to job placement. Such a system made sense (although it reinforced inequality) when only a small percentage of the population was engaged in highly skilled occupations, while most of the work force required little formal training. This condition no longer exists. Most of the needs of society can be satisfied only by the highly-skilled and the well-trained. In an era of rapid technological development even the skills of the professional rapidly become obsolete. Training cannot be considered a prerequisite for employment."[19]

The "new careers" concept thus focuses on those occupations in which on-the-job training could replace advance preparation. It departs also from the observation that societies need as much health, education, and welfare services as they can afford. There is room for expansion of existing careers in these service areas. Many more people could become qualified teachers, for example, if a process of moving up from the position of teacher's aide through a series of steps allowed them to become certified teachers. In addition, various social service "activities not currently performed by anyone, but for which there is a readily acknowledged need and which can also be satisfactorily accomplished by the unskilled worker" could be developed.[20] The attempt to design new types of careers is thus also responsive to the problem of providing meaningful work for the increasing numbers of workers who will not be able to find gainful employment in the labor force of the future.

CHANGING PATTERNS OF WORK AND LEISURE

The perceived rapidity of technological change has often called forth exaggerated notions of the development of a "leisure society." Although more careful research has shown that "average hours worked per year have been declining slowly and sporadically for a long time, with the average yearly decrease about 0.3 to 0.4 per cent,"[21] the consequences of a significant increase in leisure time are sufficiently important to merit early attention. Of equal – if not greater – importance, however, are the changes in work life that have been occurring at all levels of the occupational hierarchy in the wake of technological change.

The technological change which has resulted in the relative decline of unskilled and standardized jobs has not eliminated the need for routine and dull work. "In the complex and diversified manufacturing sector of an advanced industrial society, at least three major kinds of blue-collar factory work exist at the same time: the traditional manual skill associated with craft technology; the routine low-skilled manual operations associated with machine and assembly-line technologies; and the 'non-manual' responsibility called forth by continuous-process technology. Although craft skill will continue to play a significant role, the shift from skill to responsibility is the most important historical trend in the evolution of blue-collar work."[22]

The role of technology in allowing the worker to exercise greater responsibility runs counter to the frequently stated generalization that industrial technology produces alienation in the worker. Modern automated technology is a very different entity from the assembly-line technology portrayed in Chaplin's "Modern Times." A study by Robert Blauner of alienation among workers in diverse types of industry concludes that: "In the early period, dominated by craft industry, alienation is at its lowest level and the worker's freedom at a maxium. Freedom declines and the curve of alienation... rises sharply in the period of machine industry.... But with automated industry there is a countertrend, one that we can fortunately expect to become even more important in the future. The case of the continuous-process industries, particularly the chemical industry, shows that automation increases the worker's control over his work process and checks the further division of labor and growth of large factories. The result is meaningful work in a more cohesive, integrated industrial climate."[23]

Likewise, the introduction of electronic data processing into offices has resulted in an upgrading of the responsibility of a proportion of the white-collar labor force. In both the white- and blue-collar situations, the positive consequences of this heightened responsibility in decreasing alienation and increasing the worker's sense of importance have often been offset by the tensions which it generates. The more serious consequences of error and the need for greater concentration and alertness in handling automated machinery have caused strain for some workers. White-collar workers also resent the necessity for shift work that often accompanies the introduction of computers.

The introduction of shift work for office workers is but one indication of the growing convergence between blue-collar and white-collar work. Technological change has resulted in "a narrowing of traditional differentiation in terms of job content. What have hitherto been manual jobs, albeit with a high degree of skill, have an increasing conceptual content, and an increasing emphasis upon formal knowledge. On the other hand some clerical jobs have an increasing manual content with the advent of computers."[24] Moreover, "where the ratio of capital to labour costs is high, maximum

utilisation of plant becomes extremely important. It becomes even more necessary to avoid breakdowns and to have a reliable labour force. Granting such 'white-collar' conditions as an annual salary, improved fringe benefits is then seen partly as the price to pay for dependability.... It is also in such industries that technology has had, and is likely to have most effect upon the content of the job. The dividing line between the skilled plant operator who is 'blue-collar,' and the technologist who is 'white-collar' becomes very narrow indeed."[25] But if technological factors are fostering the convergence of white- and blue-collar jobs, social factors rooted in the historical differences between the two groups continue to inhibit such convergence.

Just as blue- and white-collar workers experience some similar tensions as a result of the new responsibilities accompanying automation, so workers in different occupational strata have similar problems as a result of the growth in the complexity of employing organizations. As technological advance has brought more levels of supervision and a more differentiated and specialized division of labor, role ambiguity is a frequent problem. This has been well documented in a national survey of 725 employed persons (matched by sex, age, education, and occupation with the employed persons reported in the 1961 census). Forty-eight per cent of the sample reported that "from time to time they are caught in the middle between two sets of people who want different things from them, and 15 per cent indicate this to be a frequent and serious problem. Thirty-nine per cent report being bothered at times by thinking that they will not be able to satisfy the conflicting demands of the various people over them."[26] The subjects also reported a lack of clarity about the scope and responsibilities of their jobs (35%) and ambiguity about what their co-workers expect of them (29%).[27] In the case of professionals, the ambiguities are compounded by competing loyalties – loyalty to the employing organization versus loyalty to the profession or discipline.

In addition to role ambiguity, there is another problem in the modern work situation which cuts across different occupational strata: the rapid obsolescence of knowledge and skills. This problem is particularly intense for the professionals whose expertise is no longer secure once acquired. If they are to retain their status, they must assimilate the new knowledge which is constantly being generated. The difficulty of this task has led to various proposals for instituting systems of continuing education and has raised questions about the adequacy of tenure and licensing systems. Should a doctor, for example, be licensed to practice medicine and retain that right automatically even if he has not kept up adequately with the more recent knowledge and techniques?

The progressive specialization and division of labor coupled with the need for greater co-operation and co-ordination between specialties exacerbates the problem. Professionals today are often faced with the need not only to keep abreast of new developments in their own specialties but also, to some extent, of those in related fields. Researchers in interdisciplinary teams, doctors in public health, and certain types of consultants serve as examples.

In management there is some tension between the need for specialists and the need for generalists. The advent of office automation has raised much discussion of "how specialised managers ought to be and how far 'professionalisation' of management should be allowed, or encouraged to go.... The prevalent view seems to be that technical background is not likely to become a prerequisite for top managers. While some students of the subject incline to the view that top managers must understand mathematical concepts, it is not generally though that they themselves need particular skills in their application. It is coming to be generally accepted that top executives need the best possible general educational background."[28] Yet Jay Gould finds that "new men are beginning to emerge at the very highest levels of command of America's leading corporations, men who speak the language not only of science and engineering but of business as well."[29] And he

attributes the increasing prominence of technical managers to the fact that "key managerial decisions today rest increasingly on technical and scientific premises that impinge upon and frequently override financial, marketing, and other business considerations."[30]

There is one work problem which is peculiar to the upper occupational strata. This is what might be called their "over-commitment" to work. While most workers have experienced some increase in leisure, the upper strata have probably lost leisure during the twentieth century. It would be difficult to determine how much of this loss of leisure has been due to the requirements of the work itself and how much to the preferences and values of the workers. But the result has been a certain alienation or disengagement from non-work activities comparable to the traditional non-concern with work activities that is manifested by blue-collar workers. As one observer has commented: "Shall we deplore the worker's lack of interest in his occupation, or the intellectual's excessive interest in work?"[31]

Most projections assume that the trend will continue so that while workers will increasingly have free time, the upper echelons will not. If the increases in leisure time for the non-elite become significant, some serious problems would be raised by this duality. As Donald Michael has expressed it: "How do we educate one segment of society to expect to have and use productively more free time and, at the same time, educate another segment to expect to have little or no free time and not to want it?"[32] The problem may be particularly pressing in view of the fact that many workers do not really want more free time. Studies have shown that "it is primarily the worker's fear of unemployment that prompts him to press for a reduced workweek, and not a desire for increased leisure.... In the absence of the unemployment threat workers would place a higher value on additional goods than on additional leisure, and... given a choice between an increase in hourly wage rates...and a reduction in working time, they would choose the former."[33]

Since future leisure time will probably take the form of lengthened vacations rather than shortened workweeks, we have had little experience to date that might indicate how this time might be filled. The only groups today who have extended free time at their disposal are the unemployed and the retired. The former suffer from a lack of resources and the psychological pains of being unemployed. The latter are often unable to make the necessary adjustment away from the work ethic. "Moreover, for many, retirement – especially early retirement – will imply that somehow one's contribution to the work-force is no longer needed..., that one is not socially valuable as one's contemporaries who have remained in the work-force or been enticed back into it."[34] The limited evidence that we do have from steelworkers with extended vacation periods indicates that there might be some increase in travel, but no substantial increase in educational pursuits, community activities, or hobbies.[35]

While some commentators take such evidence as an indication that modern man is ill-prepared for extended leisure, others maintain that leisure provides a potential for creative self-fulfillment that should be developed through appropriate planning and education. It is well to remember, however, that many social choices must be made for such leisure to become a reality – choices between increased productivity, leisure, and training programs for example. Perhaps too, a rather different solution will be found to the "leisure problem": the deliberate creation of new jobs. Such jobs would not be modelled on the make-work activities supported during the depression of the 1930's. Rather they would be set up to exploit existing individual talents and to provide new or better services to the population. Some of these jobs might take the form of payment for services that are currently rendered on a voluntary basis.

While economically useful jobs might become scarce in some future "leisure society," it may be possible for socially useful jobs to be created. A prototype of this kind of job might be that of "hand-holder" for the aged or the sick. Persons holding such jobs would serve to provide sympathetic company for persons who otherwise have little social contact. These jobs thus would serve the dual function of filling unwanted or excessive leisure time and of providing the kind of social services that will become possible in a highly productive and affluent society.

Before any such development might come to pass – if indeed it ever does – many changes are likely to occur in the patterns of work and leisure. But the most pressing problems of the immediate future concern the alterations that will have to be made in the educational and occupational structures in order to take care of those workers who are displaced by technological change and to assure the maximum possible mesh between the needs of the individual workers and the technological and economic needs of the society at large.

I.T.

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25. *Ibid.,* p. 20.

26. Robert L. Kahn, Donald M. Wolfe, Robert P. Quinn, and J. Diedrick Snoek, *Organizational Stress: Studies in Role Conflict and Ambiguity* (New York: John Wiley & Sons, Inc., 1964), pp. 55-56.

27. *Ibid.,* p. 74.

28. H.A. Rhee, *Office Automation in Social Perspective* (Oxford: Basil Blackwell, 1968), pp. 130-31.

29. Jay M. Gould, *The Technical Elite* (New York: August M. Kelley, 1966), p. 77.

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1. THE OCCUPATIONAL DISTRIBUTION OF THE LABOR FORCE

There is no disagreement in the literature concerning the long-range effects of technological change on the occupational distribution of the labor force: the progressive elimination of the least skilled occupations and the growth of professional and technical as well as white-collar work. A shift from the predominance of the production of goods to the performance of services is similarly a matter of consensus, though there is some disagreement concerning the magnitude and speed of this shift. Although over half of the labor force has been employed in the service sector since the 1950's, it is noted that women hold almost half of the jobs in services (Fuchs, Ryscavage). While Fuchs and others have dubbed our economy a "service economy," Ginzberg points out that this is true only in terms of employment, since the value of output remains considerably higher in the goods sector, and Greenberg argues that the shift to employment in the services occurs slowly and there is not likely to be any acceleration in this shift within the next ten years.

The increased importance of educational attainment for occupational success has been noted by Galbraith and Blau and Duncan, and the increased prominence – in numbers and income – of technical managers in industry has been documented by Gould. But Blau and Duncan find no indication of increasing rigidity in the American occupational structure and Stern and Johnson find that blue-collar workers do constitute a source of manpower that can be readily trained for white-collar work. Clerical work has continued to grow as paper-work has increased faster than the use of tabulators, computers, copiers, and other labor-saving equipment (Ryscavage); and general clerical workers will continue to be the largest group of office employees (U.S. Bureau of Labor Statistics). A tendency towards some convergence between blue- and white-collar work is also emerging as some skilled manual jobs have an increasing conceptual content and some clerical jobs have an increasing manual content, but the historical differences between the two categories will not be eliminated easily (Wedderburn).

Sir Denis Barnes, "Technological Change and the Occupational Structure," in *International Conference on Automation, Full Employment, and a Balanced Economy,* Rome, 1967 (New York: American Foundation on Automation and Employment, 1967), pp. 29-38.

Although "technological change is not the only thing which can affect occupational structure," it is clearly responsible for the growth of scientists, technologists, and technicians. The proportion of clerical workers in the British labor force doubled during the period from 1911 to 1951. From 1951 to 1961, however, the fastest growing group become the scientists, engineers, technologists, and industrial technicians, whose numbers and proportion of the labor force doubled. Despite the indications that unskilled and semi-skilled workers constitute a shrinking class within the occupational structure, an examination of more recent figures reveals that there is still a need for the relatively unskilled process worker who can learn a simple mechanical job. In 1961, unskilled and

semi-skilled workers still made up 40 per cent of the British labor force. Moreover, from 1951 to 1961 their share of total employment was declining at a rate of less than 0.3 per cent per year.

Peter M. Blau and Otis Dudley Duncan, *The American Occupational Structure* (New York: John Wiley & Sons, Inc., 1967), Chapter 12, "Occupational Structure and Stratification System," pp. 401-42.

An examination of historical trends reveals "no indication of increasing rigidity in the American occupational structure.... There is some indication, though the evidence is by no means conclusive, that the influence of educational attainments on occupational achievements has increased in recent decades. Migration apparently has become more pervasive and more selective of men with high potential for success than was the case in the past, making occupational chances less dependent on the accident of a man's birth place. These trends signify an extension of universalistic principles in contemporary occupational life...." Although technological advances have sometimes led to economic depressions and have sometimes brought about a routinization of formerly skilled tasks, "in the long run... technological progress has undoubtedly improved chances of upward mobility and will do so in the future. Technical improvements in production and farming have made possible the tremendous expansion of the labor force in tertiary industries – those other than agriculture or manufacturing – and, particularly, in professional and semi-skilled services since the turn of the century.... This great expansion of the occupational group at the top of the hierarchy, in combination with the simultaneous contraction of the bottom strata, has been a major generator of upward mobility. The elimination of routine jobs by automation, though it may well immediately set back the careers of some men, should ultimately open up additional avenues of upward mobility. The general principle is that as long as some jobs are more routine and less rewarding than others – and the time is hardly foreseeable when this will not be the case – incentives exist to apply scientific and engineering talents to the task of developing mechanical procedures for doing them or finding some other substitute for human labor. The recurrent elimination of the least-skilled occupations is a continual source of upward mobility in advanced industrial societies."

Since "the expansion of an occupation may be associated with the intergenerational inflow of men into it, the intragenerational inflow of men into it or both," and conversely, the contraction of an occupation may be associated with inter- or intragenerational outflow or both, there are six types of occupations. "The first type is an occupation that has expanded in the last half-century as increasing numbers of sons have moved into it, despite the fact that intragenerational mobility exhibits a net outflow, that is, in the course of their lifetime careers more men moved out of than into this occupation. The prototype of such an occupation... is clerical work, and two other cases are salesmen and operatives. The second kind is an occupation that has increased in size because disproportionate numbers of men from other pursuits moved into it in the course of their careers, although the number of sons starting this career line falls short of the number of fathers who pursued it." This type of occupation is represented by managers, proprietors, and officials, craftsmen, and service workers. "Third, one occupational group has grown rapidly as the result of both intergenerational and intragenerational mobility into it, namely, professional, technical, and kindred workers. Fourth, farming is an occupation that has declined since decreasing numbers of sons choose it as their career, despite the fact that there is a net inflow of men who had started to work elsewhere – typically in farm labor – into it. The fifth type is an occupation that has declined as disproportionate numbers who started to work in it later left for other careers, although the number of men starting to work in this occupation

exceeds the number of fathers in it. Labor and farm labor represent this type. A final possibility is an occupation whose decline is produced by both intergenerational and intragenerational outflow, but there is no empirical case representing this type."

Victor R. Fuchs, "The First Service Economy," *The Public Interest,* 2 (Winter 1966), pp. 7-17.

At some time in the 1950's, the United States became the first nation in modern history in which over half of the employed population was engaged in the rendering of services. Among the dramatic increases in service jobs from 1950 to 1960 were those in education (greater than the total number employed in the steel, copper, and aluminum industries in either year), in health (greater than the total number employed in automobile manufacturing in either year), and in finance (greater than total employment in mining in 1960). One explanation of the shift from the production of goods to the performance of services is that as income rises, the demand for goods (such as food) rises more slowly than the demand for services. Increasing demand for pleasure goods (such as boats) may belie this theory, however. Another explanation is that productivity grows faster in goods production (where technology is perhaps more readily applicable) than in services. However, we have no adequate measures of the productivity of doctors, teachers, and other service personnel which could test this theory. The rise of a service economy has had a number of discernible effects in the distribution of occupations among different types of people. In the first place, it is noteworthy that women hold almost half of the jobs in services, whereas they hold only a fifth of the jobs in the goods sector. Secondly, as a result of the rise in service work, the belief that "opportunities for self-employment are diminishing in the United States" is no longer true. Finally, service industries on the average "make much greater use of workers with higher education," even taking into account some services (such as cleaning) which do not require an education.

John Kenneth Galbraith, *The New Industrial State* (Boston: Houghton Mifflin Co., 1967), Chapter 21, "The Nature of Employment and Unemployment," pp. 233-46.

"In the early stages of industrialization, the educational requirement for industrial manpower was in the shape of a very squat pyramid.... The wide base reflected the large requirement for repetitive labor power for which even literacy was something of a luxury.... By contrast the manpower requirements of the industrial system are in the shape of a tall urn. It widens out below the top to reflect the need of the technostructure for administrative, coordinating and planning talent, for scientists and engineers, for sales executives, salesmen, those learned in the other arts of persuasion and for those who program and command the computers. It widens further to reflect the need for white-collar talent. And it curves in sharply toward the base to reflect the more limited demand for those who are qualified only for muscular and repetitive tasks and who are readily replaced by machines. This revision of educational requirements is progressive. The top of the urn continues to expand while the bottom remains the same or contracts." The industrial system "requires a progressive accommodation of educated manpower to its needs. If this accommodation is imperfect, there will be a shortage of workers for specialized tasks. And there will, at the same time, be unemployment. Both measure the failure in the accommodation." The importance of education in the modern industrial system is indicated also by the nature of the social conflicts in that type of society. "When capital was the key to economic success, social conflict was between the rich and the poor.... In recent times education has become the difference that divides."

Eli Ginzberg, *Manpower Agenda for America* (New York: McGraw-Hill Book Co., 1968), Chapter 3, "The Economic Consequences of Automation," pp. 38-52.

In contrasting the increase in employment and output in the goods-producing sector with that in the service-producing sector during the last third of a century in the United States, one finds in the goods sector "a tremendous increase in real goods without any significant increase in employment." In 1929 approximately 24 million persons turned out $122 billions of output, while in 1963 slightly more than 25 million persons turned out $311 billions of output, in constant 1954 dollars. By contrast, in the service sector, "to obtain a considerably smaller absolute increase in the value of services (from $60 to $181 billion), it was necessary to expand employment in the service sector from 23 to 43 million persons." In other words, "we have moved from a goods to a service economy *only* in terms of employment, not in the value of output." Similarly, in Gross National Product, the percentage of the total represented by the service sector rose from 33 per cent in 1929 to 37 per cent in 1963, while most of the 50 per cent increase in the total American labor force since 1929 is accounted for by the service sector. In the future, some services are likely to undergo rapid and far-reaching technological changes with correspondingly extensive changes in employment. It is likely, however, that employment in such services as education, medicine, trade, recreation, and personal services "will not be seriously affected by machines, at least not in the near future."

Jay M. Gould, *The Technical Elite* (New York: Augustus M. Kelley, 1966), Chapters 3-6, pp. 33-88.

In the context of an exploration of "the contemporary role of the technical elite in the organization and direction of American industry," Chapters 3-6 discuss the technical labor force. The technical elite in industry is defined as "those persons with training in the natural sciences or engineering who can be shown to be increasingly responsible for the enormous productivity of American industrial enterprise." Chapter 3, "The Emergence of a Technical Labor Force," details the "exponential growth rate of the technical work force in America." Chapter 4, "The Technical Labor Force in the 20th Century," notes that since 1900 the annual growth rates for all branches of science and engineering have been approximately 5%. Although there is some retardation of this growth rate, "an annual rate of 3 to 4 per cent... should generate enough forces to cope with the effects of the 'population explosion,' which in contrast is proceeding at the relatively moderate rate of less than 2 per cent per year." The growth of the technical work-force has not only continued in the 20th century, but "its productivity has expanded by the broadening of its scientific base. But what is most notable is the degree to which American industry has in this century welcomed the contribution of the scientist and engineer to technology." Chapter 5, "The Technical Elite in Industry Today," examines the absorption of scientists and engineers into industry, which "has proceeded in the past two decades at rates even higher than those governing the growth in their total number." It concludes that "as a result of the continuing scientific revolution of our time, new men are beginning to emerge at the very highest levels of command of America's leading corporations, men who speak the language not only of science and engineering but of business as well." Thus, studies have shown that technical managers – managers with technical degrees regardless of their function plus those with technical functions regardless of their education – account for six out of every ten managers in manufacturing. Moreover, there has been a persistent intrusion of "brain power" – scientists, engineers, college professors, and managers – into the top five percent of the income distribution. Chapter 6, "New Captains of Industry," argues that "key managerial decisions today rest increasingly on technical and scientific premises that impinge upon and frequently override financial, marketing, and other business considerations." A survey of the background and training of

the two top officers of each of America's 600 leading companies has "revealed that nine out of ten came from poor or middle-income families, and that four out of ten have had college level or graduate training in a natural science or engineering or equivalent on-the-job training." A series of 26 charts details the growth of the technical elite, their educations, occupations, income status, backgrounds, and their role in corporate management.

Leon Greenberg, "Is A Service Society Developing?" (Oberhausen, Germany, 1968), 42 pp. (Paper presented at the Third International Conference on Rationalization, Automation, and Technological Change, sponsored by the Metalworkers' Industrial Union of the Federal Republic of Germany).

It is important not to overestimate the swiftness of occupational change resulting from technological advances. Although "rapid and radical changes are ahead,... deeply rooted institutions, traditions, and customs are resistant to change." The shift in U.S. employment from the production of goods to the performance of services, although strikingly large over long periods, occurs slowly. In the recent past, "employment in service producing industries as a per cent of total employment has risen about 3 percentage points every five years since 1947." For the near future, "projections indicate that the average five-year rise to 1975 will be slightly less – about 2.5 points." Moreover, a closer view of the figures for 1950 to 1965 shows that of the five categories comprising the "service" sectors, only two showed a marked increase. These are: (1) services in a narrow sense, that is, educational, recreational, legal, health, personal, and repair services, where employment rose from 11.9 per cent of total U.S. employment to 15.0 per cent, and (2) government, where employment rose from 13.4 per cent of the total to 16.6 per cent. Of the other three service categories, one (finance, insurance, and real estate) rose moderately, from 4.2 per cent of the total to 5.0 per cent; one (trade) rose insignificantly, from 20.8 to 20.9 per cent; and one (transportation and utilities) decreased, from 8.9 to 6.6 per cent. Projections for the future "suggest that we need not be concerned with an acceleration in the shift from goods to services, at least for the next 10 years." But the growing demand for services is likely to produce some acceleration of technological advances in the service industries.

Maruice Lengelle, *The Growing Importance of the Service Sector in Member Countries* (Paris: Organization for Economic Co-Operation and Development, 1966).

Employment in services (commerce, education, finance, health, hotels and restaurants, recreation, and miscellaneous services such as barbering and laundering) accounted for, and are expected to account for, the following proportions of total employment in the European member nations of O.E.C.D.: around 1960, 27 per cent; in 1970, 33 per cent; and in 1980, 40 per cent. This last figure will be comparable to the 1960 level in the United States and Canada. The components which will probably rise the fastest from 1960 to 1980 are: business services, 1.7 to 5.7 per cent of total employment; financial services, 2.9 to 5.0 per cent; education, 4.3 to 9.2 per cent; and health, 4.0 to 8.6 per cent. In absolution numbers, employment in services in Europe is increasing at the rate of 1 million persons per year and will soon be increasing by 1.3 million per year.

Paul M. Ryscavage, "Changes in Occupational Employment Over the Past Decade," *Monthly Labor Review,* 90 (August 1967), pp. 27-30.

Despite the increase in the proportion of white-collar and service workers in the labor force, the celebrated breakthrough to an economy where over half of the workers are in white-collar or service work is an oversimplification if viewed without taking into account the sex of the jobholders. For even as late as 1966 only 46 per cent of the male workers of the United States were in white-collar or service occupations. It is the percentage of female workers in these occupations – 80 per cent of all employed women are in these two categories – that carries the total over 50 per cent. In absolute numbers, most of the new employees in white-collar and service employment during 1961-1966 were women. The fastest-growing occupations in this category have been typists, cashiers, and office-machine operators. The proportion of white-collar workers grew despite, and not because of, new technology. During 1956-1966, the introduction of office machines resulted in the abolition of some routine clerical jobs, but notwithstanding that fact, "clerical work continued to grow rapidly as paper-work increased faster than the use of tabulating machines, computers, duplicating machines, and other labor-saving equipment." Among professional and technical employees, the fastest-growing occupations were (1) medical and dental technicians, which grew nearly twice as rapidly as the growth of total professional and technical employment, and (2) accountants, elementary and secondary school teachers, and general technicians. Professional employment rates, taken alone, showed a smaller annual increase in 1962 to 1966 (3.8 per cent) than in 1946 to 1966 (4.8 per cent).

James L. Stern and David B. Johnson, *Blue-to-White-Collar Mobility* (Madison, Wisconsin: University of Wisconsin, Industrial Relations Research Institute, 1968) Mimeographed.

This survey of employees in Milwaukee County in 1961 and 1962 attempts to assess "the demand for white-collar skills in a market influenced by changing technology." It focuses on the following questions: To what extent are blue-collar workers actually moving into white-collar jobs? What kinds of blue-collar workers are making the change? What kinds of white-collar jobs are they moving into?The data revealed that 22 per cent of the men hired for white-collar jobs had had substantial previous blue-collar employment, thus "justify[ing] a conclusion that blue-collar workers do indeed constitute a source of trained or trainable men to meet the expanding needs for white-collar employees." Most of those who made the shift had a high school education, had some part-time schooling (in vocational, technical, or business schools) after they had begun to work, were in skilled blue-collar jobs when they changed to the white-collar category, were strongly motivated, married, and 30 to 35 years old. Substantial numbers of the former blue-collar workers, now in white-collar jobs, had done some college work but had dropped out for lack of funds or insufficient aptitude. Many had acquired the needed new technical skills (mathematics, blueprint reading, etc.) through schooling or job experience. Thirty-nine per cent of them went into supervisory jobs; 23.7 per cent, into professional and technical occupations; 20.7 per cent, into clerical work; and 16.6 per cent, into sales.

U.S. Department of Labor, Bureau of Labor Statistics. *Impact of Office Automation in the Insurance Industry* (Washington, D.C.: Government Printing Office, 1966).

"This study suggests that employment in occupations directly related to EDP and management – managers, programers, systems analysts, console and other operators – will rise, that

employment of keypunch operators may decline by 1970, and that the largest group of office employees will continue to be the general clerical group. For this latter group, the study indicates that the number of workers employed for routine operations will be greatly reduced because of EDP, but that the number of those in jobs requiring some judgment and decisionmaking – jobs that cannot be computerized, or that involve individualized response to policyholders – will remain constant."

U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Employment Patterns for 1960 and 1975* (Washington, D.C.: Government Printing Office, 1968).

"Two long-term factors are of major importance in shaping the future occupational composition of the work force." Both have the effect of increasing the proportion of intellectual and service occupations. The first is a direct result of technology: the reduction in the amount of human work required to produce a unit of output. As the need for blue-collar and farm work is thereby diminished, the proportion of white-collar and service work increases. The second factor, having the same effect, is "the somewhat greater growth in demand for services than for goods." While the demand for services is not uniformly associated with technology, it may itself be, in part, a consequence of advancing technology. Developments in transportation and communication, for example, have generated a demand for such services and facilities. However, the extent to which the demand for services is itself a result of applications of technology has not been measured quantitatively. These two long-term trends are manifested in the changes in occupational distribution that have occurred in the United States between 1950 and 1965. Employment in the white-collar and service categories showed marked increases of 43 per cent each, while employment in the blue-collar category increased by only 13 per cent, and there was a 42 per cent decline in farm work. Within the white-collar category, the sharpest increase was shown by the professional, technical, and kindred workers (98 per cent), and this occurred primarily as a result of the expansion in scientific, engineering, and technical occupations. By contrast, the traditional "learned" professions – doctor, lawyer, and clergyman – increased only slightly. The wide applications of new technologies have brought with them the need for large numbers of personnel with technical training. The trend to intellectual and service occupations is likely to continue. Projections to 1975 indicate that the proportion of white-collar workers will rise from 43.1 per cent in 1960 to 48.1 percent in 1975, and service workers from 12.5 to 14.4 per cent. At the same time, the share of the total will decline, in blue-collar occupations, from 36.3 to 33.8 per cent, and in farm occupations from 8.1 to 3.8 per cent. It is estimated that professional and technical occupations will account for 14.6 per cent of total employment in 1975. This means that "one in seven of the employed will be a professional or technical worker." The projected employment increases for each of the major economic sectors provides further confirmation of this general trend. The largest increases, proportionately, will occur in service industries, public administration, and finance, insurance, and real estate.

Dorothy Wedderburn, "Are White-Collar and Blue-Collar Jobs Converging?," (Oberhausen, Germany, 1968), 25 pp. (Document P 12-68 of the Third International Conference on Rationalization, Automation, and Technological Change, sponsored by the Metalworkers' Industrial Union of the Federal Republic of Germany).

The considerable increase in white-collar employment in most industrial societies has occurred as a result of changes in the relative importance of industries – especially the growth of professional services such as education and health – and of changes in the occupational structure within industries – especially the increased employment of clerical and technical workers within manufacturing industry. Technical change has resulted in "a narrowing of traditional differentiation in terms of job content. What have hitherto been manual jobs, albeit with a high degree of skill, have an increasing conceptual content, and an increasing emphasis upon formal knowledge. On the other hand some clerical jobs have an increasing manual content with the advent of computers." Nevertheless, "the historical differences in conditions of employment" for white- and blue-collar workers remain. These differences have their origin in a historical situation in which literate clerks were in short supply. Often, too, they "developed from the special terms and conditions of employment which grew up in many countries to govern the employment conditions of the public servant.... Pensions and general security of tenure were early privileges of the civial servant and it was in this setting that there developed many of the bureaucratic features of 'white-collar' employment – annual increments in salary, a regular hierarchy of positions for promotion, etc...." The tendencies toward convergence between white- and blue-collar workers today come, in part, from an assumption that if blue-collar workers are treated in the same way as are white-collar workers, they will develop the greater involvement characteristic of the white-collar attitude. Technological change has rendered this attitude important. For, "where the ratio of capital to labour costs is high, maximum utilisation of plant becomes extremely important. It becomes even more necessary to avoid breakdowns and to have a reliable labour force. Granting such 'white-collar' conditions as an annual salary, improved fringe benefits is then seen partly as the price to pay for dependability.... It is also in such industries that technology has had, and is likely to have most effect upon the content of the job. The dividing line between the skilled plant operator who is 'blue-collar,' and the technologist who is 'white-collar' becomes very narrow indeed.... It is notable that some of the most outstanding examples of reductions in differentials between the 'white' and 'blue' collar groups in Britain have been in the heavily capitalised, continuous-flow production industries like petro-chemicals and oil refining." Despite these technological factors, however, a narrowing of the differential treatment of the workers generally results "both from increased wealth and from increased bargaining strength of trade unions simply demanding better conditions for their members without reference to 'white-collar' conditions. Sometimes it results from competition among employers for scarce labour.... In the future it seems likely that the growth of highly skilled 'blue-collar' jobs linked with automation will lead to the development of a new strata of workers whose special employment conditions will be closer to or the same as 'white-collar' conditions. But there seems no reason why automation alone will produce a convergence between 'blue-collar' and 'white-collar' employment as a whole."

2. WORK PATTERNS AND SKILLS

Literature concerned with the effects of technological change on work patterns and skills deals principally with the nature of the worker response to technological change and the question of the worker response to technological change and the question of whether skill levels are raised or lowered as a consequence of automation. Although Clague judges the trend in skill requirements to be an upward one, a consensus appears to be emerging that in the case of blue-collar workers the average skill level is raised in some respects and lowered in others, with no conclusive or substantial net change (Bright, Froomkin, Horowitz and Herrnstadt, Mansfield). Indeed, Froomkin has attempted to put an end to the debate on this question by asserting that "the whole controversy about skills has a hollow ring." At the same time, most analysts appear to agree that for white-collar workers there is a long-term trend towards upgrading of skills (Blum, Walker, Helfgott). A larger gap between higher and lower white-collar and managerial positions is noted by some (Blum, Burack and McNichols), while others maintain that automation raises promotion prospects, especially for the younger workers (International Labor Office). Special attention is devoted to the new occupational group growing up around the computer. A study of automation in the banking industry, for example, has noted that those workers who were trained to be programmers came to feel a decreased loyalty to their employer as they began to see themselves as having highly marketable skills (Mumford and Banks); and the development of a separate professional identity and set of values by the "computer elite" is analyzed in the context of the tensions which are generated by the introduction of computers into the office (Rhee). The relationship between electronic data processing and management is a subject of some controversy. Investigators differ in their assessments of whether a higher centralization of control and a decline of middle management result from the introduction of computerized information systems (see Myers).

Several commentators point to the growth of greater tensions in employees who work with automated machinery (AFL-CIO, Stettner, Rhee). Although many workers enjoy the greater responsibility that accompanies this work, the more serious consequences of error and the need for greater concentration and alertness often produce a high degree of tension. Isolation in the work process, tighter supervision, rapid obsolescence of skill and knowledge and the consequent premium on youth, and a looser bond between managers and workers are among the other tension-generating concomitants of technological change in industry (Ginzberg). In industries that have not yet been automated, unionized workers anticipate automation with a sense of fear about the "more intangible factors" such as a reduction in the importance of their work or in their ability to exercise imagination on the job (Rosenberg).

American Federation of Labor – Congress of Industrial Organizations, *Labor Looks at Automation* (Washington, D.C.: 1966).

The effects of automation on job security have been greatest for the less skilled workers in goods-producing industries. But semi-skilled jobs will also increase far more slowly than total employment, and even jobs requiring a higher level of skill are not immune from threats of displacement. In printing, for example, computers linked with phototypesetters are replacing linotype machines and are threatening the existence of an entire skilled craft. The psychological effects of automation on the worker extend beyond the fears of displacement. For when the machine operator becomes a machine monitor or a dial checker, he must be constantly on the alert. The need for action may arise only infrequently, but he must be ready. As a result, he is under greater tension than he was in his conventional job. Supporting evidence for this contention may be found in the reported increases of nervous disorders, ulcers, and eyestrain among operators of automatic letter-sorting machines in U.S. post offices. And the physical isolation and noise level of other types of automated work have served to increase the normal tension and boredom of the work situation. A study of automated steel mills in West Germany found that the control operators were becoming increasingly nervous and slower in responding to changes of situation. The author, Ralph R. Coernmann, noted that "it is no longer a source of surprise to us to find that the heart rate is higher for the man who operates a bank of machinery by the flick of a button on a control panel than for the man who does heavy physical work."

Albert A. Blum, "Computers and Clerical Workers," (Oberhausen, Germany, 1968), 24 pp. (Document D 1-68 of the Third International Conference on Rationalization, Automation and Technological Change, sponsored by the Metalworkers' Industrial Union of the Federal Republic of Germany).

Research into the effects of technological change on the skill requirements of office work has produced diverse and contradictory findings. One reason for this is the difficulty of controlling the Hawthorne effect, i.e., the alteration of behavior by people who know that they are being studied. The many studies and discussions of the employment effects of technological change by scholars, unions, business leaders, and government officials appear to have influenced management policies. Thus, in contrast to his nineteenth century counterpart, the manager of today "is concerned when he installs a computer that if he discharges workers, first, these discharges would lower the morale of the rest of his office employees; second, a more socially worthwhile procedure would be to let attrition, transfers, or retraining take care of the surplus of employees; and third, rather than reduce salaries, one should pay the employee his old rate for a period of time." A second reason for the discrepancies in research findings can be found in the differing effects of technological change over time. A study by the International Labor Organization in 1959 found that office automation had tended to freeze promotion opportunities. But a study published by the same agency in 1967 found that, in the opinion of employers and trade unions, the net effect of automation in clerical work had been to improve the prospects of promotion. It is likely that both ILO reports are correct, for the respective times that they cover. Two long-term changes are discernible, however. First, "in some automated offices there will be a greater proportion of highly skilled clerical employees." Second, "the gap between the less skilled and the higher skilled clerk appears to be growing larger." Office employees may be divided into three groups: (1) those who do routine work involving typing, filing, sorting, etc., (2) those with both experience and seniority whose work requires slightly more knowledge of company operations, and (3) those who hold managerial positions, either technical or administrative in nature. "Automation appears to be cutting off the middle step in the old promotion

ladder in that the second group appears to be generally growing smaller." The reduction in the middle-level white collar positions often results "less from automation directly but from the reorganization of the office resulting from automation, such as the centralization of the office work. Moreover,... there may be an increase in the number of higher level jobs which will be frequently of a technical nature. If these trends continue over time, it will be more and more difficult for a clerk to rise in the hierarchy of a company. The middle steps will be missing.... It is this blocked mobility, particularly among the men in dead-end jobs, which may make these men members of the 'clerical proletariat' and prompt them into moving into unions."

James R. Bright, "The Relationship of Increasing Automation and Skill Requirements," in National Commission on Technology, Automation, and Economic Progress, *The Employment Impact of Technological Change,* Appendix Vol. II to *Technology and the American Economy* (Washington, D.C.: Government Printing Office, 1966), pp. 203-221.

In four kinds of situations, automation raises the average level of skill in some respects and lowers it in other respects, with no substantial net change upward or downward. First, when an operator requires less skill because of the introduction of automated machinery, he may be made responsible for "a larger portion of the production sequence," and this assignment may require a knowledge of additional machines that more than offsets the original decrease in responsibility. Second, in mass-production industries, skill requirements may diminish with increasing automation, but in specialized activities, such as the aerospace and missiles industries, rapidly changing technology requires "a high proportion of technically trained people." Third, in services, such as law and research librarianship, computers simplify the work of search and recall clerks, but, owing to "the growth of knowledge and the refinement...of techniques," there is a rise in the over-all or directive skills required. Fourth, a high skill requirement is involved in building, installing, and debugging a new automatic system, but, in a later stage, the skill required "reduces to the level that is readily available."

The relationship between automation and skill level is not uni-directional, however, for the level of skills available also affects the degree of automation. In fact, a "law of automation evolution" may be stated as follows: Machinery gradually evolves to provide the degree of automatic operations which is justified by economics, that is, which is "economically supportable by the level of skill that can be made readily available in the existing work force." Thus, "the machine designer ceases his efforts to simplify operation and maintenance... when the machine manning needs have been reduced to a standard that is normally available in the local work force. The economic incentive for automation progress disappears at this point."

Elmer J. Burack and Thomas J. McNichols, "Management and Automation Research Project, Final Report," (Chicago: Illinois Institute of Technology, 1968), 138 pp, Mimeographed.

This study of the effects of changes in process and process-like manufacturing technologies upon the job activities and responsibilities of industrial supervisors and managers finds that "more technically based operations, closer operating relationships between units, higher rates of output, and more control instruments are among the technological factors reshaping job demands. Management's interpretation of work system needs is shifting promotion credentials to a heavy emphasis on the degree holder. Upward movement to first-level supervisory positions and advancement

routes from these supervisory positions are being severed for the experience-based man as he increasingly faces a dead-end in job movement. A 'gap' is forming between lower and higher levels of management.... At the same time sharp departures from older processes increase psychological and energy demands under faster-paced conditions.... Yet in the wide number of areas where promotional paths are being modified the extent to which modified job and work environments call for the (technical) degree is not clearly established. There is a clear tendency to overestimate its relevance. In addition, where higher level skills are indicated, the development potential of existing company personnel is frequently overlooked." But "the decreasing relevance of individual knowledge and ability as well as decreasing ability to acquire knowledge in expanded, faster paced or more complex technologies is not confined to experience-based supervision. Introduction of computer technology, instrumentation, new electronics circuitry, high-speed mechanical systems, newer materials, power sources and scientifically-based knowledge which have developed after completion of college work also place the technical graduate under stress even where graduation has taken place as recently as in the late 1950's." The problems of readjustment in the work force take different forms in different stages of technological development. "In the more advanced technologies (e.g., petroleum refineries, chemical plants and power stations) extensive changes in organization have already taken place and problems may be described as those of a 'mature' technology. Here there is a selective or partial introduction of newer technologies, phasing out of older facilities and consolidation for economy of operation. Operational demands tend to diminish but 'housekeeping' skills and striving for greater economies come to the forefront. Problems of motivating an aging work force and turning inward for mid-career updating are some of the important issues in these industries. On the other hand, industrial segments in transition to newer technologies (as in steel, basic production of non-ferrous metals and to some extent paper pulp) are incurring the severe readjustment problems of attempting to shift from an experience to a technical-degree base." Ironically, the problem of combatting obsolescence is complicated by the fact that "in those technological situations where changes take place more slowly and anticipation time exists, companies may be less likely to undertake remedial programs. Here, the need for remedial programs is not clearly signalled." The impact of change or individual obsolescence may be mitigated by various options available in job design. But for this to occur, "closer working relationships are called for between those policy makers who commonly initiate change and the engineering and manpower groups who interpret change in terms of people and technologies.... The planning process for important technological changes typically emphasizes engineering features, capital budgeting and anticipated pay-outs. Manpower plans are most often cast in a secondary role." In information handling systems, for example, "the severe demands which computer systems impose for accuracy and standardization of work are seldom adequately anticipated.... Because production supervisors at scattered producing locations are usually responsible for the inputs of raw data but are seldom involved in helping fashion the system or in using its output, great potential exists for ineffectiveness or outright failure." It is recommended that the following methods for facilitating the change process should be employed more frequently: task forces and project teams; knowledge sharing by firms in the same industry; improving communication between technical suport and operating groups and between corporate and field levels; formal training efforts to improve the operating effectiveness of managers or the creation of planning units staffed with both facilities and manpower specialists.

Ewan Clague, "Effects of Technological Change on Occupational Employment Patterns in the United States," in U.S. Department of Labor, *Manpower Implications of Automation* (Washington, D.C.: Government Printing Office, 1965, pp. 29-38.

As our economy and our technology have become more complex, the skill levels required for many occupations have been raised. For example, the repairmen who service business machines generally need broader technical knowledge and a higher level of skill than ever before. But technological change has not raised the skill requirements in all occupations. When carpenters work with preassembled stairways, windows, and doorways, for example, the skill requirements of their work are lower than they were previously. "There is an interesting question as to whether the net effect of all technological change is to raise the average skill level in the economy. Some statistics certainly point in this direction." U.S. Bureau of Labor Statistics data indicate that: professional occupations expanded from about 8 to 12 per cent of total employment from 1950 to 1963; craftsmen were the only blue-collar group to expand as fast as total employment; and laborers decreased as a proportion of the total work force from 5.9 to 5.2 per cent. "My own judgment is that, on balance, the trend of skills is upward, but I do not have the analytical data with which to answer this question with certainty."

Joseph N. Froomkin, "Automation," in the *International Encyclopedia of the Social Sciences* (New York: The Free Press, 1968), vol. 1, pp. 480-89.

It is often alleged that skill requirements in industries with advanced technologies are higher than they are in technologically conventional industries. The proposition can be supported by two empirical findings: that the average skill level of workers in the United States has increased in every decade since 1900 and that the expansion of employment in skilled occupations is more prevalent in the technologically sophisticated industries, i.e., those with high increases of productivity per employee. At the same time, however, unskilled jobs are often eliminated "because of decisions that, have nothing to do with automation;" and in the increasingly important maintenance area, the job requirements of an automated plant are no higher, on the average, than the semi-skilled level. "The whole controversy about skills has a hollow ring." The majority of companies that have radically altered their production processes have had considerable success in retraining workers for the new jobs. This retraining was generally done under company auspices and in a relatively short time. A troublesome rise or decline in the average skill level required has been rare. Because workers without a high school diploma had difficulty in finding work during the periods of high unemployment in the late 1950's and early 1960's, some investigators concluded that the new jobs opening up in the economy require at least a high school education. The conclusion was unwarranted. Studies of the mobility of workers have shown that large numbers of them without the benefit of a high school diploma move from unskilled to semi-skilled and from semi-skilled to skilled work, in highly mechanized industries. A similar disparity between what the job inherently requires and what employers look for was found in computer programming: in 1958, programmers were required to have a graduate degree in mathematics, but six years later many programmers were high school graduates. What happens, apparently, is that under conditions of less than full employment, employers choose to hire the best educated applicants, without regard for the actual educational requirements of the job. Accordingly, if we are to increase the years of education of our young people, it would be better to justify the increase on the basis of what our society can afford, rather than on what it needs because of advancing technology. The idea that Western society in the near future might become "a utopia,

or a Calvinist hell, where work will become redundant" is also not supported by the evidence. The increased demands concentrated in the service area make this possibility especially unlikely.

Automatic processes have been resented by some categories of employees: (1) supervisors – when the introduction of new equipment has reduced the number of their subordinates and diminished their leeway in scheduling the work; (2) clerical workers – when they are transferred to second and third shifts in order to keep the computers busy; (3) older workers – who are reluctant to give up skills acquired over a period of years and who experience psychological difficulties in adjusting to new working conditions; and (4) workers who prefer physical labor. Offsetting the resentments, however, are such satisfactions as the prestige of working in a new plant; and offsetting the disaffected groups are those workers who are enthusiastic about the new ways of working. "Studies of the change-over to automatic processes have uncovered a great deal of apprehension before and during the change-over but have come to the conclusion that workers were equally or more satisfied with new working conditions after the end of the shakedown period."

Eli Ginzberg, "Technological Change and Adjustment to Work," *Journal of Occupational Medicine,* 9 (May 1967), 232-238.

Ten "potential increases in tension that are likely to be derivatives of current alterations in the work scene" are discussed: (1) isolation in the work place – "there will be more space, more distance, and more isolation, and for those people who don't like the isolation, there will be tension;" (2) tighter supervision – "as more large-scale investment is put into capital equipment, into complicated machines where possible damage due to malfunctioning can be very great, the quality of supervision, even indirect supervision, will be tightened;" (3) less homogeneous work groups – "it is clear from recent and prospective developments in American history that there will be more Negroes and other minority-group members showing up in work places where historically they have not been, and showing up as equals and even as supervisors;" (4) changes in classical corporate hiring patterns – "in a rapidly changing technological and economic environment, management will have less and less interest in a large number of older people and the bonds between management and a large part of the work force will therefore loosen;" (5) lack of transferable capital among workers – "today a man acquires security by being in an organization for a number of years; he knows how it works and he knows with whom to work. But this makes him somewhat vulnerable if he ever gets displaced;" (6) anonymity within large organizations – "the more that organizations become national or international, the more likely it is that people will feel that they are lost in these organizations," (7) excessive demands on young executives for mobility – "at crucial times in the life cycle of a man the necessity to travel, sometimes to relocate, can be disturbing;" (8) loyalty to a technical or scientific discipline – "by and large, the corporate structure looks for loyalty from its employees, but the better trained and educated people have a double affiliation, one to their discipline and one to their employer;" (9) the balance between work and nonwork – "as a function of our new affluence, we are for the first time in the history of the world, close to the margin where work, even for people who are seriously interested in their work, will absorb only some part of our emotions and energies;" (10) the increasing premium on youth – "in a rapidly changing and rapidly advancing field of knowledge and applied technology, the premiums are on the people who have been most recently trained.... [This] relative value of the youngster to the oldster is an inversion of the conventional pattern of our society." Some possible adjustments in the work place include: more trade-union activity in the white-collar area; a more structured worker-employer relationship with

due process built in; more explicit personnel policies and criteria of evaluation; opportunities for continuing education; greater supervisory discretion; and firmness of organizational policy.

Roy B. Helfgott, "EDP and the Office Work Force," *Industrial and Labor Relations Review,* 19 (July 1966), pp. 503-16.

This study of seven firms which had extensively computerized their office work — four manufacturing companies, a large bank, a large insurance company, and a small insurance company — concludes that the increase in high-level jobs and the elimination of bottom-level clerical jobs had a net effect of upgrading the office work force. In the four manufacturing companies, some new high level "analytical jobs centering around the computer" emerged. Moreover, the introduction of the computer resulted in some upgrading of the clerical work. "There appears to be a shift in the performance of certain clerical tasks from clerical workers to administrative personnel as the nature of the work becomes less quantitative and more qualitative." In the bank, fewer women were hired because of the elimination of such lower skill clerical jobs as filing clerks, proof machine operators, and bookkeepers, which are often occupied by women. Thus, while total employment increased, the raising of the skill level resulted in a slight drop in female employment. In both the large and the small insurance companies, the number of managerial jobs and of high and median grade supervisory and technical jobs rose, while the number of lower level jobs declined.

Morris A. Horowitz and Irwin L. Herrnstadt, "Changes in the Skill Requirements of Occupations in Selected Industries," in National Commission on Technology, Automation, and Economic Progress, *The Employment Impact of Technological Change,* Appendix Vol. II to *Technology and the American Economy* (Washington, D.C.: Government Printing Office, 1966), pp. 223-287.

This study of changes during a fifteen-year period in the work content and the traits and preparation required of workers in three production industries (slaughtering and meatpacking, rubber tires and tubes, and machine shop trades) and two service industries (medical services and banking) found that: "There was considerable change in occupational requirements and content, but on balance it was either inconsequential or inconclusive with respect to overall skill levels." Examples of the ambiguity of the results include the following: (1) In slaughtering and meatpacking, and in rubber tires and tubes, "educational requirements have increased but training requirements have decreased." (2) In medical services, more education or training was needed by medical specialists, general practitioners, medical technicians, laboratory assistants, and specialized nurses, while less training was needed by attendants, practical nurses, occupational therapists, and physical therapists.

International Labour Office, *Automation and Non-Manual Workers* (Geneva: 1967, Labour and Automation Bulletin No. 5).

The prospects of promotion for white-collar workers have, on balance, improved as a result of automation in offices. This has applied especially to young workers, who are flexible enough to be retrained for the new kinds of work. Some older workers, however, who previously held supervisory positions, have suffered a loss of status and of promotion prospects because they have not been able to meet the selection and training standards required for work in computer installations. The stress experienced by some white-collar workers in connection with the installation of computers

does not appear to have produced serious and long-range problems. Although the introduction of shift work for clerical employees had been a wholly new experience for them, its impact has been softened by extra cash allowances and, in many cases, a shorter work week. Most of the trade unions have adopted a favorable attitude towards technical innovation so that little industrial conflict has been generated by the automation of office work. Some unions, however, argue that the benefits deriving from the increased efficiency and productivity made possible by automation have not been distributed to the workers, particularly to those who bear the immediate brunt of the adjustment process.

Edwin Mansfield, *The Economics of Technological Change* (New York: W.W. Norton and Co., 1968), Chapter 5, "Automation, Labor Displacement, and Adjustment Problems," pp. 134-61.

In both the office and the factory, when computerization or complex mechanization is introduced, skill requirements are raised in some occupations and lowered in others. Case studies of office automation have shown that although some high-level jobs are created, such as programmer, operator, and manager of data-processing machines, the skill requirements for such jobs as posting, filing, tabulating, and key punching remained stable. The net result, then, is only a slight increase in the average grade of office skills. In the factory, the results are "much the same;" complicated metalworking equipment raises the technical skill required for tool and die makers, while numerically controlled machine tools reduce the requirements for machine operators. "The fact that the educational attainment of the work force has increased does not contradict these findings. In large part, jobs have been filled with better educated people because the educational level of the population has increased.... If the available human resources are of high quality, a market economy will adjust to the use of such resources." This phenomenon poses the problem of whether unskilled labor will be able to find any work at all in the future. Some light is thrown on this question by projections made by the Bureau of Labor Statistics, which suggest that during 1964-1975, although the number of white-collar and service workers will increase faster than the number of blue-collar workers, and the prospects for farm employment will continue to be bleak, there will be no decline in requirements for laborers; these requirements will simply decline as a per cent of the total. One of the main employment effects of technology, however, is to displace workers from particular occupations, industries, and regions, and to draw them to others. Such displacement has caused the most serious adjustment problems when it has occurred in isolated areas, and among workers with specialized skills and no alternative sources of employment. "Beyond insuring an adequate level of aggregate demand, perhaps the most important way that the government can facilitate adjustment to the adoption of new techniques is by promoting the necessary adaptability of the labor force through education and training." But industry quite properly plays the predominant role in the vocational training and retraining of the work force, with the government maintaining only a residual role in this sphere.

Enid Mumford and Olive Banks, *The Computer and the Clerk* (London: Routledge and Kegan Paul, 1967).

When the office work at the headquarters of a large British banking firm was computerized, selected bank clerks, "brought up in traditional banking methods and attitudes," were assigned as programmers "with completely new roles – those of innovator and technical specialist." They were expected to develop complicated systems for electronic data processing, get the systems accepted by

top management and applied by department heads, and put the systems into practice at the computer center. The programmers went through an initial stage of high exhilaration, when they were designing the basic programs and putting them into practice. Once this stage was completed, however and a new work procedure was established and implemented, "the excitement and the challenge disappeared." Moreover, the programmers came to have a lessened attachment to the firm. They thought of themselves primarily as possessing a particularly marketable skill, and they felt tempted to leave the bank for better-paying jobs in industry. Over a third of those clerks who had not been chosen to become programmers felt that although planning and accuracy were more important in their work than previously, the work was less interesting. A majority of the clerks felt that there was little change, upward or downward, in the amount of supervision which they received.

Charles A. Myers, ed., *The Impact of Computers on Management* (Cambridge, Mass.: The M.I.T. Press, 1967), "Introduction," pp. 1-15.

The introduction summarizes a volume of papers and discussion that emanated from a research conference convened by the Industrial Relations Section of the Alfred P. Sloan School of Management at M.I.T. in April 1966 to examine the present and future impact of computers on management organization and on the nature of managerial work. On the question of whether computers are having a centralizing effect on organization structure, participants generally agreed with the conclusion of Thomas L. Whisler that "management organizational structures dealing with the routine of repetitive tasks have become more centralized under computers. [David] Klahr and [Harold J.] Leavitt drew an analogy between computer programs and organization structures: closed-routine programs and organizations are centralized; open-routine or executive programs and organizations tend to be decentralized." George F. Delahanty's studies supported this conclusion, though he noted that computer technology may permit "more decentralization to the field, with remote access to the central data base." John Dearden asserted that the movement to decentralize into profit centers that has occurred in many complex businesses is unlikely to be affected by computers because "it was the lack of time by top management to make detailed decisions, rather than the lack of information, which was the real reason for decentralization in the first place." Various participants maintained that centralization is not a necessary result of the use of computers. Jay Forrester, for example, argued that social pressures and long-term trends will determine the degree of centralization. "Organizations that choose the path of centralization at the expense of individual initiative," he maintained, "will probably lose out competitively to more enlightened forms of organization." Zenon S. Zannetos pointed out that "a centralized organization structure may be the best way to disseminate a predetermined change, while a less-centralized or even decentralized structure may be needed to initiate change." It was agreed, however, that the data-processing or information-technology function must necessarily be centralizing because "departmental or divisional computer centers are giving way to one central data-processing operation." But central decision-making does not necessarily follow from this, since, as Klahr and Leavitt pointed out, "information storehouses are sometimes being used for centralized decision making, and sometimes as pools into which people at all levels may dip to help them make the same or more decisions than they made before." Certain types of managerial work have been significantly affected by computers, e.g., purchasing, production planning and control, inventory control, shipping and invoicing, and accounting. But Delahanty found that the managers of these functions have not decreased in numbers and may even have increased. The total middle management group may eventually shrink nevertheless if jobs opened by retirements are not filled, and if the systems design and programming

group does not continue to grow. The participants did not feel that managers as a group will be replaced by computers, even though the boundary between managerial jobs affected by computers and those which are not is shifting. There will always be unstructured decisions to be made. Moreover, at the higher levels of management, tasks are likely to be more "amorphous" and to "generate flexible, open, non-hierarchical structures." Man-machine interaction, using real-time and time-sharing computer technology may thus be particularly important. Managers may be able to ask "what if" questions about price policies, markets, product mixes, and so forth. Donald C. Carroll observed that "the larger and messier the problem, the more important it is to use man-machine cooperation rather than trying heuristically to program the whole decision." Training of future managers will have to be different than in the past, for management will have to become more research- and systems-oriented.

H.A. Rhee, *Office Automation in Social Perspective* (Oxford: Basil Blackwell, 1968), Chapter 4 "Impact of Office Automation on the Individual: Work, Functions, Role and Status," pp. 113-157.

Despite the absence of any consensus as to the qualifications required for computer programming and systems men, there "some resemblance to professions in the attitude of the computer elite to their occupation and in the implied standing of the occupation in the eyes of the community. Those at the apex of the computer elite have an accumulation of expert knowledge, beyond the layman's power to assess. Hence a relationship tends to develop which resembles more that of professional or expert to client than employee to employer." The 'computer elite" is beginning "to develop a sense of professional identity and values" which sets them apart from other office workers. "The danger to the bureaucratic pyramid of setting computer specialists apart from other civil servants was seen by the U.S. civil service, probably the largest computer user in the world. The American Civil Service Commission firmly opposed the establishment of a special computer career service. Without understanding the difficulties, they considered it essential that the new specialists should be integrated. In the British civil service also it was decided not to create a new specialist grade for programmers." The advent of office automation has raised much discussion of "how specialised managers ought to be and how far 'professionalisation' of management should be allowed, or encouraged to go. Whether authority will slip from the general managers, and whether the new technologists will tend to become managers, will depend on such factors as the speed with which major decisions have to be made, the experience necessary to make the decisions and the relationship of the different levels of management. The prevalent view seems to be that technical background is not likely to become a prerequisite for top managers. While some students of the subject incline to the view that top managers must understand mathematical concepts, it is not generally thought that they themselves need particular skills in their application. It is coming to be generally accepted that top executives need the best possible general educational background." The great majority of office employees "continue to work in administrative units which come into only indirect contact with the new system.... Many of them do work which has the character of personal service and is therefore not easily transferable to computers. A large proportion of office employees, we do well to remind ourselves, work in small firms few of which have work done by computer service bureaux.... Findings regarding the effect of e.d.p. on non-supervisory office employees diverge widely. This may be explained partly by variations in the basic conditions of organizations where e.d.p. is introduced, partly by the different levels of utilisation of electronic data processing and partly by the degrees of adaptability of the individuals concerned. Case studies show that many of the problems which arise are really unresolved old problems which are aggravated and spotlighted by the innovation, for example people in jobs for which they are not suited.... All observers note that e.d.p. calls for greater accuracy on the part of the individual

member of the staff whose work is used as input for the new system. In the past, clerical errors were often avoided by creating additional levels of employees to check and double-check work done. By this means, many errors were detected before the output phase. Under electronic data processing, the checking is done by machines rather than people. The source and the individual responsible for a particular error are therefore more easily detected." Tensions and conflicts also arise as a result of the disparities between the speed of the computers and the speed of human calculations, the belief that e.d.p. results in a division between the computer specialists and other privileged workers on the top and the undifferentiated masses "who think that they will be required only until the system is fully automated," and the fact that e.d.p. results in a change in the flow of data and communications which is often not accompanied by changes in the formal channels of communication. "On the whole, e.d.p. seems to have brought about greater dependence of groups upon each other. For example, in the case of an accounts department, a specific number of accounts had to be processed each day. Individuals had to work to a stricter work rhythm set by the group, as a whole, and each group in accordance with the pace of the others.... The need to avoid at all costs a breakdown of the system tended to induce management to discourage inter-group rivalry and to deal severely with marginal employees. Reactions of employees to these tendencies are often negative."

Jerry M. Rosenberg, *Automation, Manpower, and Education* (New York: Random House, 1966), Chapter 5, "Socio-Psychological Considerations," pp. 76-88.

This chapter reviews the results of various studies concerned with the attitudes of workers towards automation. A study of workers' views about the prospect by automation conducted by the author in two major unions in New York revealed the following: "workers are greatly concerned with a loss of decision-making responsibilities, a decrease in individual job satisfaction, and a decline in group morale. Foremost in their minds is the fear that automation will require little of their imagination and they will lose their sense of identification with the job because they will no longer feel that they are doing something worthwhile." Those workers who had at least a high school education had a "more positive attitude toward the impact of automation on working conditions and home life. Those who had four or more persons to support had a negative reaction to training as a solution to problems created by technological conversion;... those who had seen co-workers displaced because of advanced mechanization tended to have poorer attitudes toward it. On the other hand, factors of age, years with company or union, salary, marital status and union position... had nothing to do with the formation of these attitudes." Fears of automation are based primarily on "the more intangible factors," since the worker "is secure in knowing that his union will take care of him in terms of wages, working conditions, transfer, and lay-offs." Moreover, the fears are often "based on speculation." Many workers "had no previous experience with automation but had a mental image based on newspaper headlines, radio and television commentaries, and union discussions."

Leonora Stettner, "Survey of Literature on Social and Economic Effects of Technical Change," in Jack Stieber, ed., *Employment Problems of Automation and Advanced Technology: An International Perspective* (London: Macmillan, 1966), pp. 451-479.

"Does technological progress result in a general upgrading of jobs? It is impossible to give a categorical answer." But some tendencies may be detected: (1) many completely unskilled routine jobs are disappearing; (2) many workers with skills of a higher level and a wider range are required

in technologically advanced industries; and (3) the content of the semi-skilled job is changing not only in the direction of less emphasis on manual dexterity, but also toward more emphasis on mental abilities, perception, knowledge, and responsibility. "There is a clear-cut trend toward a levelling of job qualifications, a narrowing of skill differentials, more interchangeability of workers, a wider grasp of the job process by the average worker, and a blurring of the distinction between manual and intellectual labor." In many respects working conditions have been improved as a result of technological change. The physical environment in the workshop is safer and more attractive. Machines have taken over the tasks which are less pleasant and more strenuous, repetitive, or routine. Workers tend to have greater physical mobility on the job, a grasp of several related processes, increased opportunity for exercise of judgment, resourcefulness, and responsibility, and more frequent contact with the technical staff. But nervous strain and mental fatigue are often increased by the greater noise and faster tempo of the work, the lack of control over the pace of work, the need for constant alertness and close concentration, and the heavy burden of responsibility imposed by awareness of the serious consequences of error.

Kenneth F. Walker, "Personal and Social Planning at the Plant Level," (Oberhausen, Germany, 1968), 26 pp. (Document D 11-68 of the Third International Conference on Rationalization, Automation, and Technological Change, sponsored by the Metalworkers' Industrial Union of the Federal Republic of Germany).

When offices have been automated, a number of routine, low-skill operations have usually been taken over by the computers, thus raising the average level of skill in the office. The magnitude of the rise has not been very great however, since the number of jobs so affected has generally been a small proportion of the total. In many cases, the disappearance of low skill jobs has not been accompanied by any change in the duties performed by the remaining workers. In other cases, however, the elimination of routine tasks has freed individual workers to concentrate upon the more demanding aspects of their work. This has been especially true in banks, where staff members who had previously divided their time between bookkeeping and service to customers have been able, since the introduction of computers, to concentrate almost entirely on the latter functions.

3. SOCIAL IMPLICATIONS AND PUBLIC POLICY

Although most analysts agree with the general conclusion of the National Commission on Technology, Automation, and Economic Progress (the "Automation Commission") that the rate of economic growth rather than technological change is the principal determinant of employment and unemployment, there is much concern about how to handle the problems of adjustment that arise as technological change generates new jobs requiring new types of skills and facilities and different locations. The many recommendations proposed to deal with the resulting lack of co-ordination between labor supply and demand include: new provisions for training and retraining (Automation Commission, Bright, Lecht, Nelson, Peck, and Kalachek, Sackman); the institution of sabbaticals for workers for the purpose of training and education (Automation Commission, Shelley); establishment of a national job information system (Automation Commission, Bright); manpower planning and improved mechanisms for the identification and development of talent (Faunce, Piore, and Shaw); systems of income maintenance (Automation Commission, Theobald); provisions allowing for the relocation of workers (Automation Commission, Bright, Lecht); the requirement that employers give advance notice of layoffs and shutdowns (Nelson, Peck, and Kalachek); the establishment of a system of "new careers" (Pearl and Riessman); and the establishment of the Federal Goverment as an "employer of last resort" for the "hard-core unemployed" (Automation Commission). The problems of social choice in the allocation of resources among productivity, leisure, and retraining goals are discussed by Faunce, Lecht, and Kreps and Spengler.

A major problem connected with the future growth of leisure time is that the workers will increasingly have more time at their disposal while the upper strata will not (Bright, Kreps and Spengler, Michael). This raises the problem of how to educate one segment of the population to value free time, while another segment must be educated to want and expect little free time (Michael). Future growth in leisure is likely to take the form of long vacations rather than a shorter working day or work week (Kreps and Spengler, Michael). One study of workers experiencing their first 13-week vacation found that while they enjoyed this free time, they did not use it to develop new interests, participate in community activities, or engage in educational pursuits (Klausner). Among the problems considered in the analysis of future leisure time are: the retention of the work ethic (Kreps and Spengler, Michael, Theobald); the tendency towards routinization in the use of free time (Kreps and Spengler); and the conflict between the creative use of free time and the economic requirements for high consumption of goods (Michael). Kahn and Wiener project the variety of attitudes towards work that are likely to obtain in a future leisure society.

James R. Bright, "Technology, Business, and Education," in Walter J. Ong, S.J., ed. *Knowledge and the Future of Man: An International Symposium* (New York: Holt, Rinehart and Winston, 1968), pp. 199-214.

Most frequently, the effect of new technology is to generate greater economic activity than it destroys. However, "(1) there is not a one-to-one correspondence between old and new activities; (2) it is almost certain that the new jobs will not be in the same geographic locations; (3) the new technology will not require the same mix of skills and facilities; and (4) there will often be a serious time lag in economic activity while the adjustment is made." As a result, there is a need for "some kind of a national job-information system" to match the new jobs with displaced employees. Mechanisms must be developed to insure the necessary mobility and to provide for the needed training and re-training of workers. While operating skills frequently are reduced, there is an increase in the skills required to design, install, and maintain the new machines and processes. It is incumbent upon the society, therefore, to "improve institutions for updating education and providing retraining and new, specialized knowledge and skill" and to assume responsibility for the costs of retraining and relocation, some minimum job security, and devices to ease social shock to the family.

The larger social problems resulting from technological change include the possible need for a new definition of work as work hours diminish and leisure time grows, and the question of what constant change, mobility, reeducation, and new activities "do to an individual's life, which now has become highly fragmented?" Moreover, "for the first time in history, workers have free time and sufficient affluence for leisure pursuits, but now the intellectually elite (the professionals) are frantically paced. Shall we deplore the worker's lack of interest in his occupation, or the intellectual's excessive interest in work? There is a disturbing gap here – and a very puzzling one. Moreover, the communication gap between the professional and his family, his employees, and other professionals is growing because of high specialization."

William A. Faunce, *Problems Of An Industrial Society* (New York: McGraw Hill, Inc., 1968), Chapter 2, "Automation and Industrial Society," pp. 39-83.

"One source of confusion in the debates about the probable effects of automation... is that distinctly different types of technological change have been called automation. For many industrial workers, the term has come to mean any new labor-saving device that causes unemployment.... The production process can be divided into four basic components with which more or less independent technologies are associated. The first of these is power technology, which deals with the sources of energy used in production. A second is processing technology, which refers to the tools and techniques used in the actual operations performed upon raw materials. A third is materials-handling technology, which deals with the transfer of materials between processing operations. The final component of production technology is control, or the regulation of quality and quantity of output.... Technological advance in each component occurs in two phases: First, substitution of inanimate for human performance of the function and second, increases in the efficiency of the machinery that is introduced.... We are currently witnessing the emergence of a separate technology of production control. Computers, sensing instruments, and feedback devices are examples of developments in this area. Automation... refers to the automatic, centralized control of an integrated production system." Mechanization refers to the substitution of mechanical for human handling of materials between processing operations. Industries may be classified into four degrees of technological sophistication: (I) advanced automation, (II) beginning automation, (III) advanced

mechanization, and (IV) beginning mechanization. In the United States today "only a small proportion of the labor force is employed in industries at either the beginning or the advanced stages of automation; 1.45 per cent of total employment is in category I industries and 4.53 per cent in category II. Even if we consider the employees in those industries from category III which appear to be moving most rapidly toward automation – printing, rubber, insurance, machinery, textiles, primary metals, motor vehicles, aircraft and missiles, and food-processing industries such as grain mills and bakeries – an additional 11.2 per cent is all that would be added to the proportion of the civilian labor force most directly affected by automation. Forty-one per cent of employed persons are in category IV industries. Taking account of self-employed persons and large numbers of government employees such as teachers who might also appropriately be classified in category IV, it is apparent that well over half of the employed civilian labor force is in industries that are developing very slowly, if at all, toward automation.... There has been relatively greater stability in our occupational structure since 1958 than in the preceding years. One reason for this may be the fact that there has been a leveling off of the introduction of automation in the consumer-durable goods industries since the peak period between 1950 and 1958." It must be noted, however, that "technological change does not occur in a smooth, unbroken sequence but rather in spurts of development. The gradual accumulation of minor improvements in processing and materials-handing techniques may eventually make it possible to move rapidly toward the complete integration of production processes around automatic controls in many more industries." Moreover, "complacency regarding the probable effects of automation would be justified only if we were adequately adjusting to current technological changes and could anticipate that the rate of introduction and type of new production technology in the future would not differ from the present. Neither of these assumptions appears to be warranted.... Unemployment among teen-age entrants into the labor force and the inadequacy of individual and institutional preparation for the use of leisure time" are examples of "problems to which current technological change in a contributing factor.... And... automation is only *one example* of a direction in which production systems are evolving, although it is the one which is currently the center of attention." The problem of unemployment stems from a lack of coordination between labor supply and labor demand. But the lack of such coordination may also result in "a failure to make the most effective use of the talents existing in the labor force. In the absence of rationalized procedures for occupational choice in industrial societies, realization of the productive potential of the labor force becomes less likely. At the very least, an improved program of vocational counseling in the schools – an instance of rationalization – should decrease the frequency of occupational drift, increase the frequency of occupational choice, and make it more likely that people will find jobs commensurate with their abilities.... Lack of preparation for leisure is also an example of a lag between the development of rationalized procedures for dealing with a problem and the emergence of the problem in the course of rapid social change." There are also some important value issues involved. "If the rate of technological change begins to exceed our ability to adjust to it, to what extent should the introduction of new production techniques be controlled? What price in individual freedom of action would we be willing to pay in order to eliminate unemployment among teen-age Negroes in urban ghettos? Although it seems obvious that we are becoming an increasingly leisure-oriented society, it is not nearly so apparent that we *should* become so. The increased national product resulting from a continuation of the present pattern of working hours plus increased productivity could be used to improve a wide variety of services, such as public education, that are not now adequately financed."

Herman Kahn and Anthony J. Wiener, *The Year 2000* (New York: The Macmillan Company, 1967), "Functions of Work," pp. 208-211.

It is suggested that in the year 2000, the following basic attitudes toward work might obtain: (1) work as "interruption" which provides "short-run income;" (2) work as "job" which provides "long-term income" and "some work-oriented values (one works to live);" (3) work as "occupation" which provides "exercise and mastery of gratifying skills – some satisfaction of achievement-oriented values;" (4) work as "career" which involves "participating in an important activity or program, much satisfaction of work-oriented, achievement-oriented, advancement-oriented values;" (5) work as "vocation (calling)" which provides "self-identification and self-fulfillment;" and (6) work as "mission" which involves "near fanatic or single-minded focus on achievement or advancement (one lives to work)." At this time, "one could easily imagine that many Americans from 'normal' (i.e., not deprived) backgrounds will increasingly adopt the first position, that work is an interruption, while many formerly in the lower and economically depressed classes will increasingly shift to the second or third positions which reflect more work-oriented and achievement-oriented values. On the other hand, the man whose missionary zeal for work takes priority over all other values will be looked on as an unfortunate, perhaps even a harmful and destructive neurotic. Even those who find in work a 'vocation' are likely to be thought of as selfish, excessively narrow, or compulsive.... To the extent that recruitment into the service professions is greatly expanded because of the reduced need for people in manufacturing, routine aspects of public administration, and automated administrative and managerial tasks, several problems will arise. One is that it will be perhaps more difficult to recruit people to do difficult and demanding work that either requires long and arduous training or requires working under difficult, dangerous, or frustrating conditions. If the hours of work of people in these professions go down severely, the incentives and psychological functions of membership in the profession may be somewhat diluted. For example, a hospital may have three head nurses if there are three shifts; what happens, however, when there are six or eight shifts? To what extent is authority, expertise, and satisfaction diluted when power, responsibility, and status are so fractionated?" Although the standard of living in the year 2000 will be greatly enhanced as a result of a projected threefold increase in GNP, "skilled, personal services requiring irreducible quantities of human time, training, and talent would become both absolutely and relatively expensive. Thus there would probably still be a very strong demand for, and probably also a much expanded supply of expensive and skilled professionals, managers, entrepreneurs, artisans, technicians and artists.... This group may well be much too busy and well rewarded to be alienated." Furthermore, since there will still be a class of luxury goods that are very expensive, most workers will retain an incentive to work rather than wishing for the workweek to be further shortened.

W.J. Klausner, "An Experiment in Leisure, *Science Journal*, 4 (June 1968), pp. 81-85.

This study of steelworkers who had had a 13 week vacation found that a large majority reported that they enjoyed the vacation very much. "Most of the respondents felt that they were happier during the vacation period than when they were working... [and] that the experience served to draw the family together and to strengthen their relationships with their children and with their spouses." The overwhelming majority of the workers did not take on any additional work; many travelled. "Slightly more than 38 per cent felt that their feelings about retirement had become more favourable during their extended vacation." From the results of this study "it can at least be hypothesized that the family of the blue collar worker in the United States is strongly

capable of handling extended leisure, and will grow and flourish with the increase of leisure time." On the other hand, "our respondents provide us with some justification for concern and that concern arises from our knowledge of what they did not do during their vacation. They did not, for example, reach out into the community; they did not increase their church or other organizational activities; they did not volunteer their services in the local public or private welfare agencies; they did not increase their participation in educational projects. Few new interests, hobbies, or educational plans were developed. It could well be that such omissions were quite natural in the enthusiasm and freedom of the first extended vacation. It may be that future and repeated periods of free time would be more strongly orientated towards personal growth and development and towards some kind of social contribution. Our respondents did not reveal any strong inclination towards such developments, however, and this may be significant."

Juanita M. Kreps and Joseph J. Spengler, "The Leisure Component of Economic Growth," in National Commission on Technology, Automation, and Economic Progress, *The Employment Impact of Technological Change,* Appendix Vol. II to *Technology and the American Economy* (Washington, D.C.: Government Printing Office, February 1966), pp. 349-97.

"The definitions of leisure are many. At one extreme, the term is used to denote all nonworking time; at the other, it applies quite restrictively to that time which is completely free of commitments – contemplative time, in short. The concept of leisure as 'discretionary' time has also been developed, and for many purposes that is the most meaningful use of the word leisure." Most of the rise in free time during worklife in the past century has resulted from a shorter workweek. But "whereas the major gains in workweek reductions occurred early in the century, growth in leisure via paid vacations (particularly for wage earners) has been largely a postwar development.... In addition to the 1,200 hours of leisure per year during his worklife, a substantial increase in free time is now available at the beginning and end of man's labor force experience. Of the 18½ years of added life expectancy about 9 are spent outside the labor force, primarily in increased education and training and in retirement." Various alternative allocations of leisure in the future are possible. Thus, in 1980, "given a $4,413 per capita GNP..., achieved with a 37½-hour workweek, a 48-week workyear, and providing retraining for 1 per cent of the labor force, society could choose to retrain much more heavily (4.25 per cent of the labor force per year), or alternatively, could add 1½ weeks per year in vacation. In 1985 when per capita GNP should reach about $5,000, the choice could be between retraining almost 7 per cent of the labor force annually or taking an additional 3 weeks of vacation. Obviously, other choices could be made, involving a further reduction in the workweek, a lowering of retirement age, or an increased educational span for those entering the labor force." Though technology "makes goods ever more abundant and makes free time more plentiful, conceivably up to 365 days a year," time will always "remain scarce in relation to all its potential uses." Nevertheless, "it is primarily the worker's fear of unemployment that prompts him to press for a reduced workweek, and not a desire for increased leisure... in the absence of the unemployment threat workers would place a higher value on additional goods than on additional leisure, and... given a choice between an increase in hourly wage rates... and a reduction in working time, they would choose the former." Moreover, leisure time itself tends to become structured. "[T]hat portion of leisure long enjoyed tends to become ordered by habitual and institutional guides, whereas new increments of leisure remain uncommitted for a while, but not necessarily permanently. Accordingly, while economic development enlarges man's range of choice, it may also circumscribe it. Of course, technological or other changes can produce profound changes in the pattern of

consumption of families and hence in their patterns of leisure use, but these in turn tend to become routinized." Studies of the use of leisure time in various occupational groups reveal that "the upper strata have probably lost leisure during the 20th century." As studies by Harold Wilensky have shown, "man's quantitative gains in leisure have been exaggerated, and the quality of leisure, being more rigid and fragmented, is far from ideal. Persons with leisure today are of occupational and age groups that are either motivated and able to choose leisure over income, or are forced into leisure because of inadequate job opportunities. The former cut across class lines, including college-educated engineers and the upper working class; the latter are concentrated in low-income and low-status jobs where 'leisure' takes the form of unemployment and involuntary retirement." But such analysts as David Riesman have noted that since we are "at the frontier of the development of leisure, there are of course conflicts in attitudes toward its use. Knowing very little about what leisure means to people... assumptions are made that may in fact considerably understate the Nation's capacity for activities which earlier work schedules have prohibited."

Leonard A. Lecht, *Goals, Priorities, and Dollars* (New York: The Free Press, 1966), Chapter 16, "Manpower Retraining," pp. 306-18.

"As the pace of technological change accelerates, there is an increasing likelihood that individuals who already possess job skills will need to learn two or more occupations during their working life.... The remedies for unemployment caused by inadequate growth in demand are to be sought in monetary and fiscal policies for increasing effective demand. Unemployment may also be caused by rigidities in the structure of labor markets – arbitrary age limits in hiring, retirement plans tending to discourage new hirings, racial discrimination, unrealistic hiring specifications by employers, or an unwillingness to relocate by employees. While Government policy must deal with these causes, training would be of little use in combatting them.... Experience with manpower retraining in the United States has been too limited for a consensus to emerge regarding the appropriate number of trainees or the types of training needed." But the experience of Sweden may offer a guidepost to the United States; their experience shows an annual total training need of 1 percentage of the labor force. "The civilian labor force in the United States is expected to grow to 83 million persons in 1970 and to 91 million by 1975. Accepting the 1 per cent standard as a reasonable objective for the United States in the coming decade would mean increasing the employability of 800,000 or 900,000 unemployed individuals a year through retraining in the 1970's." If training programs for the hard core unemployed were to include literacy education and social service assistance and "if half the trainees in the work loads projected for the 1 per cent target in the 1970's were unskilled semiliterate workers selected for the combined program, over 400,000 persons a year" would be involved. "Costs per student for literacy education and social service assistance would probably be less than for job training because the basic education course is typically shorter, and less equipment and facilities are required.... Total spending for the retraining goal is estimated to rise to $2.9 billion by 1975. This is almost $2.5 billion more than the cost of continuing the level of training envisaged by the Administration in the mid-1960's for another decade. Measured by GNP, the cost of introducing the greater labor market flexibility and the second chance opportunities represented by retraining are small – less than 1/3 of 1 per cent of GNP."

Donald N. Michael, "Free Time – The New Imperative In Our Society," in William W. Brickman and Stanley Lehrer, eds. *Automation, Education, And Human Values* (New York: School & Society Books, 1966), pp. 293-303.

Since a "cybernated society" requires continuous-flow operations, it is unlikely that increased leisure time will take the form of either shorter work weeks or fewer work hours per day. Instead, there will be longer vacations and "sabbaticals," so that "a substantial portion of the population may well be faced with the opportunity or problem of living with a large block of free time." At least for the next few decades, top-level managerial and professional elites will not have more free time than now. Their wives, and other non-working women, will have more free time as "a new source of baby-sitters and other home services may arise from the surplus of unemployed women displaced from clerical work by computers.... Then there will be that large portion of the population composed of the semi-professionals, the skilled, and the more mediocre professionals,... [and] at the bottom of the heap... a substantial population, poorly paid or unemployed.... Also in this group will be high school dropouts and the students from schools which will not provide opportunity for longer study hours or the stimulus to use them." While the adolescent and young adult group "probably contains the greatest proportion of souls seeking a sense of self and of calling, and it is the group freest to experiment with self and environment in the quest,... many of these youths who are devoted to craftsmanship or are commitment-oriented are very likely to be more heavily time-involved in education. Most of those young people who lack the motives or the abilities to be so involved very probably will continue to be the consumers of fads...." Similarly, "the wives of the overworked top-flight professionals also present a potential opportunity for developing the effective use of free time. Their free-time activities might become the approved style just because it is done by the right women." On the other hand, "most wives may prefer to keep conventionally busy rather than face the challenge of free time" and many of their husbands "will be too work-occupied to respond to their wives' discoveries and styles.... The older and retired seem to offer potentially the best medium for the constructive and elaborate development of free-time activities. In the first place, by being older and retired, they *ipso facto* have done their work. Thus, according to the Protestant ethic, they are entitled to rest, relaxation, and recreation.... On the negative side, there are now many older people or retired people, and there will be proportionately more, who cannot make the shift comfortably from the Protestant work ethic. Moreover, for many, retirement – especially early retirement – probably will imply that somehow one's contribution to the work-force is no longer needed..., that one is not so socially valuable as one's contemporaries who have remained in the work-force or been enticed back into it." Looking to the past for models of proper use of leisure is not fruitful. The ancient Greeks had only a small population of citizens and there were not so many Greeks per civic unit among which to apportion the various activities (politics, theatre, philosophy, etc.). "But it is also true that for the Greeks a lot of free time was frittered away drinking with friends, fighting wars, and enjoying the very frequent festivals put on at government expense. Incidentally, women were denied all public and civic participation. As to the leisure classes of recent history, even this small elite... for the most part either was bored or preoccupied with intrigue, the pursuit of love and license, and given to various forms of violence (from fox hunting to assassination and warfare). Some were creative, pursuing farming, politics, and science – all areas now well past the point where most amateurs can contribute significantly to them. And, too, the masses worked and the elites had the free time. Now we are faced with a social inversion, with the masses leisured while the elites work.... If my reading of history is correct, we are on our own and will have to invent our own ways of making more free time a blessing rather than a curse." These are also some questions about the use of leisure in a society of our kind: "Is the goal of self-fulfillment through creative free-time activity at all compatible with the requirements of an economy which depends

Upon the voracious consumption of leisure-time gadgets, mobility, and all those other things which one gets now and pays for later?... The basis for a prosperous economy could be changed, of course, and, in doing so, both public welfare and private leisure might benefit handsomely, but such a change would be radical in many eyes. The other major question has to do with the extent to which we really mean to pursue excellence during free time.... If we really are concerned with pursuit of excellence,... then we are rejecting the mass-market approach, placing the emphasis on individual accomplishment and variously deprecating or separating from the talented those who can be no more than mediocre. It will take a subtle value system, indeed, to insure that, on the one hand, those who can excel are encouraged to do so and that, on the other hand, the limits of others will not result in their discouraged withdrawal into trivial leisure.... The last fundamental issue is that of education for valuing free time. How do we educate one segment of society to expect to have and to use productively more free time and, at the same time, educate another segment to expect to have little or no free time and not to want it? How do we encourage more students to study longer and harder and, at the same time, develop in other students styles for free-time use – free time which will be comparatively greater for them than for the other students, even during their school years?"

National Commission on Technology, Automation, and Economic Progress, *Technology and the American Economy* (Washington, D.C.: Government Printing Office, 1966), Vol. 1, Chapter 4, "Facilitating Adjustment to Change: Public Policies," pp. 43-58 and Chapter 8, "Technology and the Work Environment," pp. 89-93.

In order to assure that jobs or income will be available to workers who are displaced from present employment, the Commission recommended: "(1) fiscal policy calculated to provide at all times a brisk demand for labor; (2) direct employment of any long-term residue of unemployed workers; and (3) income maintenance for families with inadequate earnings." Various improvements in the education system are also needed. "From the purely economic point of view, education has three principal effects: (1) it can increase the versatility and adaptability of people with respect to vocations and thus increase their capacity to adjust to change; (2) it can open up increasing opportunity to persons who might otherwise have difficulty in finding and holding employment; and (3) it can increase the productivity of workers at any level of skill or ability." For the necessary training and retraining of workers, "one promising approach would be for management and labor to develop programs under which workers would be encouraged to engage in full-time education during periods of layoff and during negotiated sabbatical leaves." The Commission also recommended the establishment of a "computerized nation-wide service for matching men to jobs;" flexible patterns of retirement; the establishment of a single standard of pay; and consideration of the possibility of "a system whereby individuals could continue their education by allowing them to 'charge off' or earn tax credits for that education which is necessary for the development of new skills." While such questions as the establishment of a single standard of pay are questions "which devolve on industry and labor..., to declare these matters of public policy is... to declare them matters of community conscience, requiring us to set up public standards by which we can judge ourselves."

Richard R. Nelson, Merton J. Peck, and Edward D. Kalachek, *Technology, Economic Growth, and Public Policy* (Washington, D.C.: The Brookings Institution, 1967), Chapter 6, "Technological Change and Employment," pp. 113-33.

"Full exploitation of the benefits of technological advance" requires a reallocation of human and material resources. But it also requires "that those released from superseded activities find productive work. If the men previously involved in producing steam engines stand idle for long and the resources newly employed in the production of diesels are drawn from high value alternative uses, the net value of the output increase generated by technological advance may even be negative." Moreover, "technological change has implications for employment composition far beyond the industry where the change is occurring.... Employment in any industry is affected not only by its own technical change and productivity advance, but also by progress elsewhere.... For instance, advances in airline technology have increased employment in resort areas and in aluminum production, but reduced employment in railroads." As such employment changes occur, "workers must be prepared to shift jobs. The broad education acquired by most young Americans gives them the ability to learn to perform a wide variety of jobs. Further, they show considerable willingness to move in order to find an attractive job. Therefore, the human costs of foreclosing certain job opportunities which employed a significant fraction of the older generation would not appear to be particularly serious for youth. To be sure, society may develop a certain footloose quality, and the gap between generations may be widened, but compared with the problem of job insecurity, these costs appear minor." But for older workers, the trauma of being "tossed into the job market again, and the frequent necessity to lower standards of living which they reasonably expected to be perpetuated, rank among the major inequities of technical change.... For the present, the most promising public policy measure would be that of requiring employers to give advance notice of major layoffs and plant shutdowns. The United States Employment Service... is currently experimenting with a voluntary program of advance notification. Although results are not yet available, it seems unlikely that widespread compliance can be obtained on a voluntary basis, since advance notice will impose costs on employers in terms of adverse publicity, premature loss of employees and lowered productivity of the remaining work force." Public policy should also be geared to giving "workers affected by plant closedown... a priority call on the limited resources available for labor market purposes. This may require a reorientation of the federally financed retraining program, which is currently focused on reducing overall unemployment by remedying skill shortages, and hence on retraining younger workers. A higher proportion of retraining resources could be devoted to long tenure workers who are displaced, or about to be displaced, and whose generally low position in the hiring queue seems socially undesirable."

Arthur Pearl and Frank Riessman, *New Careers For The Poor* (New York: The Free Press, 1965), Chapter 1, "Poverty and New Careers for Nonprofessionals," pp. 1-20.

"Many functions currently performed exclusively by professionals must be delegated to persons with limited education, experience, and skill. Society insists that training take place prior to job placement. Such a system made sense (although it reinforced inequality) when only a small percentage of the population was engaged in highly skilled occupations, while most of the work force required little formal training. This condition no longer exists. Most of the needs of society can be satisfied only by the highly-skilled and the well-trained. In an era of rapid technological development even the skills of the professional rapidly become obsolete. Training cannot be considered a prerequisite for employment." All societies need as much health, education,

and welfare services as they can afford. The thesis which underlies the "new careers" concept is that: "in an affluent automated society the number of persons needed to perform such tasks equals the number of persons for whom there are no other jobs." Thus, "the new career concept has as a point of departure the creation of jobs normally allotted to highly-trained professionals or technicians, but which could be performed by the unskilled, inexperienced, and relatively untrained worker; or, the development of activities not currently performed by anyone, but for which there is a readily acknowledged need and which can also be satisfactorily accomplished by the unskilled worker.... Persons filling entry positions must have latitude for limited advancement without being required to undergo extensive additional training. This type of opportunity is generally available to governmental and private agency personnel assigned to clerical or non-professional services.... Establishing a continuum ranging from nonskilled entry positions, extending through intermediate sub-professional functions, and terminating in full professional status, changes the nature of the upward mobility in our society. No longer would professional status be attained *only* by first completing between five and eight years of college.... A sequence beginning with the unskilled aide and proceeding through an assistant (two years of college equivalence plus experience); an associate (four years of college equivalence plus experience); and terminating in an accreditation as professional is manageable and opens areas to which the poor can now hardly hope to aspire.... The unique quality of the new career proposal might be best emphasized by consideration of the present inability of a registered nurse to obtain credit for training and skill toward becoming a medical doctor. It is proposed that ultimately such a course would be available."

Michael J. Piore, *Technological Change and Structural Adjustment in the Labor Market,* Unpublished Ph.D. Dissertation, Harvard University, 1966.

This study of technological change in 17 manufacturing plants found that "when technological change creates new jobs which differ radically from existing jobs and major revisions in blue-collar skills are required, the engineers responsible for the change are withdrawn from the innovative process to man the new equipment and teach the new skills. This has the effect of slowing further innovation until the labor force has adjusted to the changes which have already occurred." Built-in limitations in the skill structure and in skill adaptability and the short run fixity of capital equipment and scarcity of investment funds also slow the pace of technological change. Because of these delaying factors, the plant acquires the time needed to develop the skills of their workers. For the most part, the continuous character of "manufacturing technology and the process through which it is improved reduce the likelihood that new jobs will differ radically from preexisting ones and foster a continuity in job requirements which permits adjustment through on-the-job training to take place relatively smoothly without imposing intolerable costs upon the plant." Moreover, "innovations developed by the supervisor and the operator will usually be tailored automatically to the abilities of current employees."

Such in-plant mechanisms for adjusting new skill demands with the skill capacities of the employees do not, however, obliterate the need for manpower planning in the society at large. The task of formulating manpower policies, especially in the manufacturing sector, often requires analytical tools which have not yet been developed. It is suggested that a system should be set up in which "manpower forecasts would be constructed by committees of plant personnel managers and industrial engineers joined by governmental officials and professional educators." Groups of this kind are probably required for both industrial and geographic manpower planning. They could be arranged to parallel the structure of government through a network of national committees with subcommittees on the state and local levels.

Harold Sackman, *Computers, System Science, and Evolving Society: The Challenge of Man-Machine Digital Systems* (New York: John Wiley and Sons, 1967), Chapter 12, "Computers, the Scientific Spirit, and Evolving Society," pp. 551-599.

The apparently irreversible loss of jobs in the face of rising automation has led many American commentators to believe that society must soon discard its working ethic (the "Protestant ethic"), which asserts that work is noble and morally obligatory, and must replace it with a new ethic of leisure and individual self-fulfillment, in an age of abundance. This is an unwarranted simplification, not only of the problem but also of the solution, for the millennium in which a few men and many computers can make everything grow is not yet in sight. To cope with a rapidly changing technology, "it is becoming increasingly apparent that lifelong learning featuring some form of periodic or continuing education and retraining will supersede the traditional one-shot approach to formal education. Scientists, engineers, and technicians have been among the first to feel the need to be continually brought up-to-date in their rapidly changing fields. This educational deficit can not and should not be handled entirely by formal educational institutions. Indoctrination and training on the job, through professional societies, and at home are supplementing and expanding education at the schools.... If on-the-job training is extended and pushed to its limits, the total educational effort in government, business, industry, and in our economic institutions broadly considered may eventually reach and surpass the educational time and effort expended in schools and universities."

Edward A. Shaw, "Speculations About Man and His Work – A.D. 2000," *Personnel Journal*, 46 (July-August 1967), pp. 419-426.

It seems likely that to cope with the complexities of industry and life in the year 2000, society will face an increasing need for "uncommen men, new elites of skill and resourcefulness," who can work in the area of unstructured problems, where computers are inadequate. Society will need "to identify individuals with potential for membership in the elite..., to develop means for nurturing their growth and development, and to provide them with privacy and the ever-increasing dimension of time." The government and business should cooperate in developing the elite and in allocating without waste the scarce human abilities of these individuals who can contribute to the national progress and to technology.

In personnel management, we can anticipate the establishment of a computerized central human resources exchange, where a paramount problem will be to develop a method of giving both the individual and the organization some degree of choice. Government and business will have auxiliary obligations besides the allocation of human resources. Government will be expected to assure economic security, and opportunities for the profitable use of leisure, for those displaced by technological advance. Business will probably use displaced semi-skilled workers in company-sponsored athletic teams, and skilled clerks and librarians in a company museum or a company history project.

Edwin F. Shelley, "Earned Educational Leave: A Proposal," in Juanita M. Kreps, ed. *Technology, Manpower, and Retirement Policy* (Cleveland and New York: World Publishing Co., 1966), pp. 193-197.

"A national system of Earned Educational Leave could... insure the constant refreshment of skills, knowledge, and personal outlook that each individual requires in order to live with effectiveness, dignity, and pleasure in a society marked by rapid change and technical complexity." Suppose we took 5 per cent of the people at work and gave them a year of education and retraining. Suppose, in fact, we took every worker out of the labor force for one year after he had worked for 20 years, and arranged for him to be paid his salary for being educated during that year. This would leave openings which our unemployed could fill.

If national productivity (and unemployment) should increase, we could remove, say, 10 per cent instead of 5 per cent of the labor force each year, which means that every worker could take a year's education after only 10 years of work. There would then be that many more jobs for the unemployed to fill. In practice, nine months of the year's leave might be devoted to education and training, and three months to travel, recreation, or leisure.

Kent D. Shinbach, "Technology and Social Change: Choosing a Near Future," *Mental Hygiene,* 52 (April 1968), pp. 276-283.

Work, as Freud observed, seems to be necessary for our normal functioning. This need is fostered through our upbringing and is embedded in our calendar. When people are deprived of work, they sometimes develop psychopathological tendencies. The great majority of people are not emotionally or psychologically ready for extensive free time. But in 40 years or less only one-fourth of the population will be involved in what we now call work, and even they will usually work only three eight-hour days a week. Thereafter, a time will come when jobs and workers will be outmoded concepts. Those of us who now look forward to, cherish, and celebrate the weekend are probably the last adherents of a fading cult.

Is there a viable alternative to work? Or is the need to work only artificial? Is it possible that degrading work will be replaced with degrading leisure? Perhaps learning – paid learning – is destined to become the major kind of regular activity. "Of all the current professions, teaching alone may continue into the twenty-first century in recognizable form." There will always be work for teachers.

Robert Theobald, "Should Men Compete With Machines?" *The Nation,* 202 (May 9, 1966), pp. 544-550.

Hitherto, the main economic obligation of society has been to ensure that a man who wants a job should be able to find one. Leisure was not a primary concern of society. Now, however, society has other obligations: (1) to promote, through applications of technology, the fullest amount of unemployment, that is, freedom from the necessity of regular, prolonged periods of work, and (2) to develop financial mechanisms that will enable the individual "to act as an institution, self-directed, and alone responsible for his actions." Society has crippled many people for

creative enjoyment of leisure, by orienting them toward productivity. Now, "as their productive efforts are no longer required, society must not only provide them with rights to adequate incomes but must also provide new types of activities that will give them a sense of satisfaction in their lives."

A system of basic economic security is appropriate to the era of cybernation. Under it, everyone will receive an adequate income and will be challenged to develop himself and his society. Our schools and universities must promote creativity and enlarge the capacity of the individual to think in terms of his own uniqueness. Some individuals who do not need to work regularly will engage in a special activity. They will produce the custom-designed objects and services that have been vanishing in the present economy.

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